



GOOD GARDENING PRACTICES IN BARCELONA: CONSERVING AND IMPROVING BIODIVERSITY



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Barcelona



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A garden, a habitat

Gardening in the city, public and private alike, brings remarkable benefits. Public green spaces offer a wide range of services: social, environmental, regulatory, cultural etc. Green spaces are privileged areas for health, enjoyment, meetings and relaxation. Private green spaces also offer the city environmental and ecological services, through gardening, a special interaction with nature. All together, the city's green areas therefore constitute an asset that encourages quality urban living. Barcelona has been promoting an expansion of green spaces and ways of managing them that favour ecosystem services and biodiversity conservation.

It is within this context that this manual has been prepared, entitled *Good gardening practices in Barcelona: conserving and improving biodiversity*. The manual is a technical tool for disseminating good practices that will help to maintain quality green spaces, through work, above all, on their structures; the aim here is to improve their habitat conditions and thereby enable collaboration in the development of the flora and animal groups, vertebrates and invertebrates alike. It therefore encourages not just the conservation and improvement of the natural heritage, but also a richer contact between city residents and urban nature. The proposals it contains can be applied to both public and private areas.

Its contents are organised into seven main chapters: lined trees; shrub groups and hedges; grasses, fields and grasslands; urban allotments; aquatic environments and ponds; cliffs, walls and party walls; courtyards, small gardens, balconies, terraces and green roofs. Each of the chapters features conservation and biodiversity-improvement initiatives. The conservation strategy is basic and aimed at preventing the loss of our rich range of flora and fauna. For example, not using chemically synthesised phytosanitary products in urban allotments is a conservation initiative; by contrast, creating margins with shrubs and herbs to enrich habitats is an improvement initiative. The city offers shelter to a valuable range of flora and many species of protected fauna that require sensitive management and which have a useful ecological function, such as controlling urban insect populations, of direct use not just for city residents but also for keeping certain pests in check.

The manual takes an in-depth look at the relationships that arise in every natural ecosystem between the soil, vegetation and fauna, as well as the measures we can take to boost natural processes and relationships between their elements. We are talking about promoting a strategy for naturalising the city and making it a more balanced ecosystem, something that will necessarily benefit biodiversity conservation and the well-being and health of everyone.



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INTRODUCTION

One of the most outstanding components of the urban environment are lined trees. Trees are found in parks, squares, gardens and, most especially, streets and avenues, making up rows that can reach several kilometres in length. Barcelona is one of the European cities where trees are most evident, with some 160,000 specimens of lined trees that help to make up for the lack of large-sized green spaces in some districts, such as Eixample. On the other hand, some of the city's parks —such as Montjuïc, Laberint d'Horta and Parc del Guinardó— boast large woodland areas.

Lined trees provide environmental benefits to the entire urban system: they reduce the effects of atmospheric pollution; regulate temperatures by tempering warming caused by the “urban heat island” phenomenon and prevent loss of heat during the winter; they capture CO₂, which is the gas that contributes most to the greenhouse effect, and increase biodiversity. With regard to this latter aspect, trees lining streets act as connectors between green spaces, as they enable fauna to move from one to the next, and each specimen constitutes a focus of attraction in itself for various animals, invertebrates and birds in particular.

As far as biodiversity is concerned, you can currently find over 150 species in Barcelona's streets. Plane trees are by far the most abundant species. Note that many plane trees which can still be seen in public spaces date back to the second half of the 19th century. The last few years have seen other species making inroads into this dominance by plane trees, despite these remaining the identifying trees on the city's major avenues. This is because their dominance in the city poses a high risk for lined trees in the event of widespread disease and also presents adaptation problems in an urban context (droughts, pollution, etc.)

Diversification strategy

Diversifying Barcelona's lined trees, along with an identifying criterion, has become a long-term strategy that has been applied since 1995, to protect and improve this natural heritage. The aim is for lined trees to adapt well to Mediterranean-climate conditions — and in this sense to ensure they have no great water or fertilisation needs — ensuring they are capable of resisting the very pressure of the urban environment and can adapt to the specific features of the spaces they are allocated to, to provide maximum environmental services. And, in addition to these considerations, the criterion of giving preference to native species or even to species that correctly adapted to our climate long ago.

We also need to take account of other aspects that promote biodiversity when it comes to selecting species, such as fruiting, which encourages the presence of fauna. Not to mention that the large old trees form hollows that are usually occupied by birds.



Managing lined-trees

Managing lined trees has to take account of issues such as pruning and use of phytosanitary products. The tendency is for moderation in both cases, avoiding excessive pruning and overuse of certain products to control pests and diseases. This is generally a complex form of management, as it involves a type of work that has a major impact on public spaces and also has consequences that are highly visible within the urban landscape. Interventions on the city's trees need to find a balance between function and environmental improvement, if we are to obtain healthy trees, properly introduced in each context, which bring environmental services and are maintained as a cornerstone to biodiversity.

Using biological phytosanitary treatments to conserve biodiversity



Seven-spot ladybird (*Coccinella septempunctata*)

Description/application

→ A commitment to biological control. This strategy involves fighting against alignment-tree pests and diseases through their natural enemies, whether predators, parasitoid or pathogens. It means using organisms (useful fauna) that act against pests and help to reduce their population levels. To give a few examples of biological controls through direct predation, we could mention the control carried out by seven-spot ladybirds (*Coccinella septempunctata*) on aphids (fam. *Aphididae*) or vedalia beetles (*Rodolia cardinalis*), another type of ladybird, on the cottony cushion scales (*Icerya purchasi*). The larval stage of hoverflies (flies that resemble wasps) are also aphid predators. A species from the *cales* genus (*Cales noacki*), a small wasp, acts as a parasitoid against whitefly (*Aleurothrixus floc-*



Aphidius colemani. Photo: Xelo Ribes

cosus) and is becoming a key biological control of this plague in citrus cultivation. Also common is the use of a predatory true bug (*Anthocoris nemoralis*) for controlling sycamore lace bugs (*Corythuca ciliata*), although it is worth pointing out that the results obtained in cities have not been fully satisfactory. That same true bug, however, has shown very effective results in controlling jumping plant lice (*Cacopsylla pulchella*), a pest that affects Judas trees (*Cercis siliquastrum*) and which excretes sticky secretions, lerps, which soil cars, urban furniture and pavements.

These are all examples of biological control. (See *annexe 1: Biological control in Barcelona*).

→ Biological insecticides are used: for tackling pests and diseases through the direct use of living creatures or natural products (chemically synthetic products are excluded). Note, however, that certain biological insecticides, such as *Bacillus thuringiensis* bacteria, which are frequently used for tackling pine processionaries (*Thaumetopoea pityocampa*), are not selective and can therefore adversely affect the pest's natural predators.

→ Pheromones, inhibitors and repellents are used for tackling pests and diseases.

It is true, however, that some incidents in Barcelona become emergencies and therefore require a rapid response. This means that a comprehensive management model combining chemical methods and biological control is becoming the most appropriate strategy in the urban context we are facing. Likewise, however, preference has to be given to biological-control methods and pesticides should be used as a last resort.

Royal Decree 1311/12, establishing the framework of action for a sustainable use of phytosanitary products, and the Register of Phytosanitary Products authorised by Spain's Ministry of Agriculture, Food and Environment, are the reference documents that have to be followed.

Selecting the period for applying phytosanitary treatments so they do not interfere with species' life cycles



Eurasian blue tit (*Cyanistes caeruleus*)

Description/application

➔ The life cycles of species of fauna associated with lined trees must be taken into account. Action should be taken outside the breeding periods for birds and bats (from March to July) and the mating period for bats (from August to October). Attempts must be made to avoid acting on trees where winter bat colonies have been detected. These mammals use several nesting substrates throughout the year. During the spring they look for warm shelters for establishing their breeding colonies whereas during the winter they use other shelters for spending the cold season in and establishing their hibernation colonies.
(See *annexe 2: Biodiversity associated with trees: annual cycle for bats*).



Common pipistrelle (*Pipistrellus pipistrellus*).
Photo: Sergi Garcia.

So, before any treatment is applied, the time of year has to be taken into account and, in any case, where there is an urgent need for action, an exhaustive inspection must be conducted to detect the presence of fauna associated with the lined trees that are to be treated. Where there is an emergency and where breeding of protected birds and bats has been detected, the Generalitat of Catalonia's Cos d'Agents Rurals must be informed of this (*consult the list of protected species of native wild fauna in Legislative Decree 2/2008 approving the consolidated text of the Animal Protection Act. Generalitat of Catalonia*).

	birds	bats
January		●
February		●
March	●	●
April	●	●
May	●	●
June	●	●
July	●	●
August		●
September		●
October		●
November		●
December		●

● Breeding seasons of birds and bats

● Bat mating season

● Bat hibernation

Diversifying alignment-tree species *to protect against vulnerabilities associated with dominant species*



Passeig de Sant Joan's lined trees

Description/application

→ Barcelona City Council has a plant-species diversification programme whose goal is for no species of alignment tree to exceed 15% of the city's total number of trees by 2062. The aim here is to prevent the presence of dominant species from attracting pests or diseases or to prevent any other environmental change from being able to adversely affect the city's tree heritage.

→ With lined trees, the interests of the actual trees are often limited by the physical features of their replacements and make pruning work essential if such trees are to coexist with the city. Note here the importance of selecting species of lined trees and shape pruning so trees can adapt to their available spaces.



Male house sparrow (*Passer domesticus*) rearing its young in a hollow. Parc de la Ciutadella.

→ We need to highlight the ecological role they play as the city's green-space connectors, as nesting substrates for finches (mainly goldfinches, greenfinches and serins) providing branches for them to build their nests between during the spring and offering hollows, when the trees are old and large, that are occupied by house sparrows (*Passer domesticus*), great tits (*Parus major*), common wall gecko (*Tarentola mauritanica*), lizards and also bats, among other animals.

Selecting species of trees to improve the quality of the habitat



Parc del Laberint d'Horta

Description/application

The criteria for selecting species of trees depend on numerous factors. Some of these are general criteria, such as climate, environment, sustainability, coexistence, durability and permanence; others relate more to the trees' actual biology (consult the Depart of Green Spaces and Biodiversity's Manual for managing street trees). Special attention to certain selection criteria is required here in order to boost the associated biodiversity:

➔ Native species have to be planted, as they allow greater interaction with local fauna. These include, to name but a few examples, olive trees (*Olea europaea*), holm oaks (*Quercus ilex*), Aleppo pines (*Pinus halepensis*), downy oaks (*Quercus pubescens*), sweet bay trees (*Laurus nobilis*), wild cherry trees (*Prunus avium*), pomegranate trees (*Punica granatum*), white mulberry trees (*Morus alba*) and southern nettle trees (*Celtis australis*), the latter being the host plant of nettle tree butterflies (*Libythea celtis*).

The adult females of this butterfly look for southern nettle trees to lay their eggs on, so their larvae can feed off their leaves. Common hawthorns (*Crataegus monogyna*) are also a host plant for a lovely species of butterfly, scarce swallowtails (*Iphiclides feisthamelii*).

There are many examples which demonstrate this relationship between native flora and fauna, although species do adapt over time and make use of the resources that the alien species offer them. It is well known, for example, that a large number of birds, including warblers, feed on the fruit of glossy privets (*Ligustrum lucidum*) and that blackbirds incorporate the seeds of Japanese mock oranges (*Pittosporum tobira*) into their diet.



Olive trees in Parc de la Trinitat



Scarce swallowtail (*Iphiclides feisthamelii*).
Photo: Wikimedia

➔ Fruit-producing species that are useful for fauna need to be boosted. Nettle trees, holm oaks and oaks, blackthorns, common hazel trees etc., and fruit-bearing trees in general, offer fruit that is used by the city's birds. Nettle trees and their fruit are used by a whole range of birds, including blackcaps (*Sylvia atricapilla*), blackbirds (*Turdus merula*), song thrushes (*Turdus philomelos*) and European robins (*Erithacus rubecula*), to name but a few, as well as small mammals, as a source of food. It is therefore a good example of a tree that has adapted perfectly to the city and which offers us, moreover, interactions with local fauna, thereby increasing the complexity of habitats. Even so, the suitability of this criterion has to be assessed in some cases, especially where lined trees are concerned and where their fallen fruit requires extra cleaning work.

In such cases, we can opt to plant these species in parks and gardens.

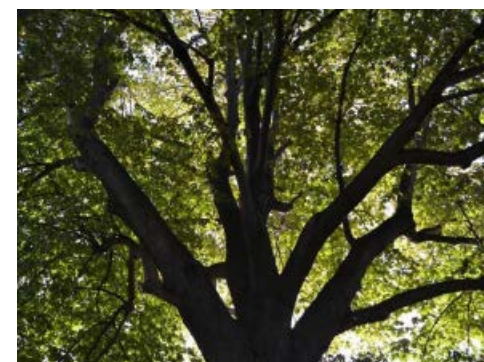


Parc del Laberint d'Horta



Common hawthorns (*Crataegus monogyna*) and blackthorn (*Prunus spinosa*) fruit

➔ Species that produce flowers which are attractive to pollinating insects must be boosted. Trees such as field maples (*Acer campestre*), Montpellier maples (*Acer monspessulanum*), common hawthorns (*Crataegus monogyna*), olive trees (*Olea europaea*), wild cherries (*Prunus avium*), cherry plums (*Prunus cerasifera*) and large-leaved lime trees (*Tilia platyphyllos*) present flowers containing nectar and high levels of pollen, which are at the disposal of pollinating insects.



Silver lime tree (*Tilia tomentosa*) in Parc del Laberint d'Horta



Judas trees (*Cercis siliquastrum*) in Plaça Joanic

➔ Species of trees with well-developed boughs need to be boosted, for use as a nesting substrate for goldfinches (*Carduelis carduelis*), greenfinches (*Carduelis chloris*) and serins (*Serinus serinus*), among other birds, where the size of the site so allows. Note, however, that small and average sized species presenting dense foliage, such as callery pear trees (*Pyrus calleryana*) or oriental cherry trees (*Prunus serrulata*), to give but two examples, can also be used for nesting.



Plane trees along Carretera de Montjuïc's



Holm oaks along Avinguda Diagonal

➔ Ruling out the use of invasive species which pose a risk of undermining nearby natural spaces, owing to their ability to propagate and re-sprout. An example are black locusts (*Robinia pseudoacacia*) and trees of heaven (*Ailanthus altissima*). Consult the Study on invasive species in Barcelona and the proposal for alternative species on the City Council's website.

Pruning needs to be made compatible with the presence of fauna *to foster biodiversity*



Tawny owl (*Strix aluco*).
Parc de les Corts
Photo: David Garcia.

Description/application

→ Where green pruning is carried out during the breeding period (spring), special care has to be taken to detect nests on boughs or in hollows and cracks where birds and colonies of bats and squirrels can shelter. (See **annexe 2: Biodiversity associated with trees**). Barcelona City Council is currently preparing an internal procedure that proposes putting a halt to pruning work where nests occupied by birds are observed. Where necessary, signage can be put up informing citizens of the reasons for halting the work.

→ During the winter campaign, attention needs to be paid to the presence of cracks and hollows in forest, park and garden trees that may contain colonies of bats, given their use of such substrates for hibernation. It is true, however, that most bats in Barcelona during this time of the year usually look for shelter outside the city for hibernation purposes, such as deep and isolated hollows with little variation in temperature.



Common magpie nest (*Pica pica*).

→ Avoiding heavy pruning, wherever possible, as this weakens trees and prevents large boughs from developing that are used by many birds. Such pruning may only be used where necessary and for reasons of public safety. It is true, however, that such heavy pruning (lopping and dividing-up) has led to a large number of hollows that birds such as sparrows and tits readily use for building their nests in. In any case, such continued pruning has ended up affecting the vigour of trees and their capacity to compartmentalise the cuts that are caused.



Plane trees in Parc de la Ciutadella.

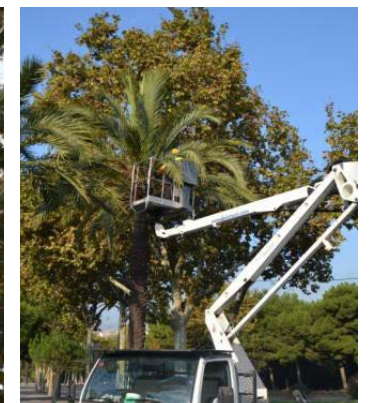
→ Monk parakeet (*Myiopsitta monachus*) is a species indigenous to South America which, as a result of accidental or deliberate releases and its great capacity for adapting to our environment, has reached high population levels, with some 5,000 in Barcelona (data from the Barcelona Public Health Agency in 2015). Using several substrates for nesting, adapting to several types of food, highly successful breeding and a lack of natural predators are just a few of the factors that explain this species' high population level.



Monk parakeets (*Myiopsitta monachus*) feeding in the grass.



Monk parakeet nest on a date palm tree (*Phoenix dactylifera*).



Work removing monk parakeet (*Phoenix dactylifera*) nests.

Royal Decree 630/2013 includes monk parakeets in its Spanish catalogue of exotic invasive species, so a suitable form of management has to be studied and planned to reduce their population levels.

Managing woodlands *to create mature urban forests*



Parc del Laberint
d'Horta's forest
area

Description/application

➔ The city's woodlands need to be planned in a way that not only respects natural successions but also promotes the presence of mature urban forests that meet the habitat requirements for many of the various species of fauna. The forest's maturity results from the ageing dynamics of its tree cover, which are associated with a series of processes, such as the shaping of hollows, closing of boughs and opening up of clear spaces, caused by disturbances to the environment and the decomposition of dead wood.

➔ It is therefore recommended that forests are managed so they have larger trees, with a diverse range of tree species and a good vertical vegetation structure, so that the herbaceous, shrub, lianoid and tree layers are well represented.



Photo: Andrés Flajszer

Leaving dead trees standing *to boost biodiversity*



Dead tree in the
Jardins del Mas
Ravetllat

Description/application

Trees that have died through competition with other trees, ageing, snapping from gusts of wind and other natural causes still have important ecological functions that generate biodiversity.



European green woodpecker (*Picus viridis*). Photo: Wikimedia



Short-toed treecreeper (*Certhya brachydactyla*) looking for food on the bark of a Judas tree (*Cercis siliquastrum*)

→ A dead tree of a certain size that remains standing is used as a feeding substrate for many species of insectivorous birds and, also, as a breeding substrate for several species that occupy tree hollows. Species such as European green woodpeckers (*Picus viridis*) and the great spotted woodpecker (*Dendrocopos major*) choose dead and branchless trees for carving out their nests, as they present a softer texture.

Woodpeckers are territorial birds that usually change their nests every year and therefore leave behind a series of hollows at the disposal of other species of birds, such as the great tit (*Parus major*), the Eurasian blue tit (*Cyanistes caeruleus*), the European crested tit (*Lophophanes cristatus*) and the short-toed treecreeper (*Certhia brachydactyla*) but also some species of bats and squirrels (*Sciurus vulgaris*). Old woodpecker nests are becoming more important in young forests and pine groves (where fewer hollows are produced than in oaks, holm oaks and poplars).

→ The recommendation, then, is to choose very specific areas in forest zones off the beaten track where various dead trees can be left standing; access to these areas can then be closed off, to prevent any risks to public safety. For these purposes a professional can analyse the possible risks of falling trees and, therefore, the feasibility of such action. It may also be advisable to carry out some reduction pruning on these dead trees and so minimise any risk of falling branches. In any case, this action will provide feeding opportunities for various species of fauna and will enable several species of birds to carve out their nests there.

Managing dead wood *to boost biodiversity*



Decomposed trunk
in the Jardí de les
Hespèrides

Description/application

Dead wood provides a habitat for the survival of many species of fungi, mosses and various saproxylic invertebrates (which feed on decomposing dead wood), whose presence is directly connected to this availability of dead wood found in forests. Some of these groups take part in the decomposition processes of organic matter and the recycling of nutrients, while others are also food for groups of fauna higher up the food chain, mainly birds such as woodpeckers, treecreepers and tits, as well as reptiles and mammals such as shrews and hedgehogs.

Managing accumulated dead wood therefore helps to generate biodiversity. Quite a separate thing, and with very different effects, are the exceptional disturbances from large-scale falling and dead trees that can pose a risk by attracting forest pests and diseases. We need to make sure the ecosystem's capacity for processing such dead wood is not overloaded.

→ It is advisable to ensure the presence of dead wood in forest areas by maintaining what is created naturally. This is a simple measure that does not require any intervention.

→ Cutting and pruning work can be exploited in young and immature forests lacking dead wood and thereby used to contribute a certain quantity of dead wood that can be uniformly distributed all over the area acted on, or for accumulating small numbers of trunks. The optimum quantity needed for boosting biodiversity is hard to specify. Factors such as quality (degree of decomposition), productivity, depending on the type of forest in question, and climatology are variables that are hard to establish a response to in that respect and which are currently being studied.



Maintaining tree hollows to boost biodiversity, without putting public safety at risk



Hollow in a Box elder (*Acer negundo*). Note the presence of a European common gecko.

Description/application

→ The availability and quality of tree hollows is a limiting factor for the fauna that use them as a breeding, refuge and hibernation substrate. Numerous birds, as well as mammals such as bats and rodents, reptiles and many invertebrates (snails, slugs, spiders, cockroaches, moths etc.,) are regular users.

→ There is strong inter-species competition for better-quality hollows in forest areas with a shortage of hollows. Less competitive species will have to choose poorer-quality hollows, in other words, hollows close to the ground and vulnerable to the predation that comes with them, small-chamber hollows or hollows with entry holes that are too large. It is advisable, therefore, for forest areas to present a large number of uniformly distributed hollows, as many animals switch them from one breeding season to another, to reduce risks of predation or the presence of parasites.

→ It is therefore advisable to respect the hollows found in forest trees that arise from falls or cut branches, malformations or compartmentation problems, provided they do not compromise public safety.



Hollow in a plane tree

Planting plant species in tree pits to boost the presence of useful fauna



Alfalfa (*Medicago sativa*) in tree pits, Montjuïc



Parc de les Rieres d'Horta

Description/application

→ A good way of boosting biodiversity is to plant useful plant species in alignment tree pits, especially in areas of the city where biological controls are carried out. Working with plants that offer us extended periods of flowering with a useful nectar-secreting content and which are sufficiently rural to support the pressure of the urban environment will enable us to have a reserve of useful fauna available to tackle tree pests and diseases. (See *Urban Allotments. Annexe 1: Useful plants for beneficial fauna*).



Planting lavender (*Lavandula officinalis*) in tree pits. Ceràmiques Vicenç



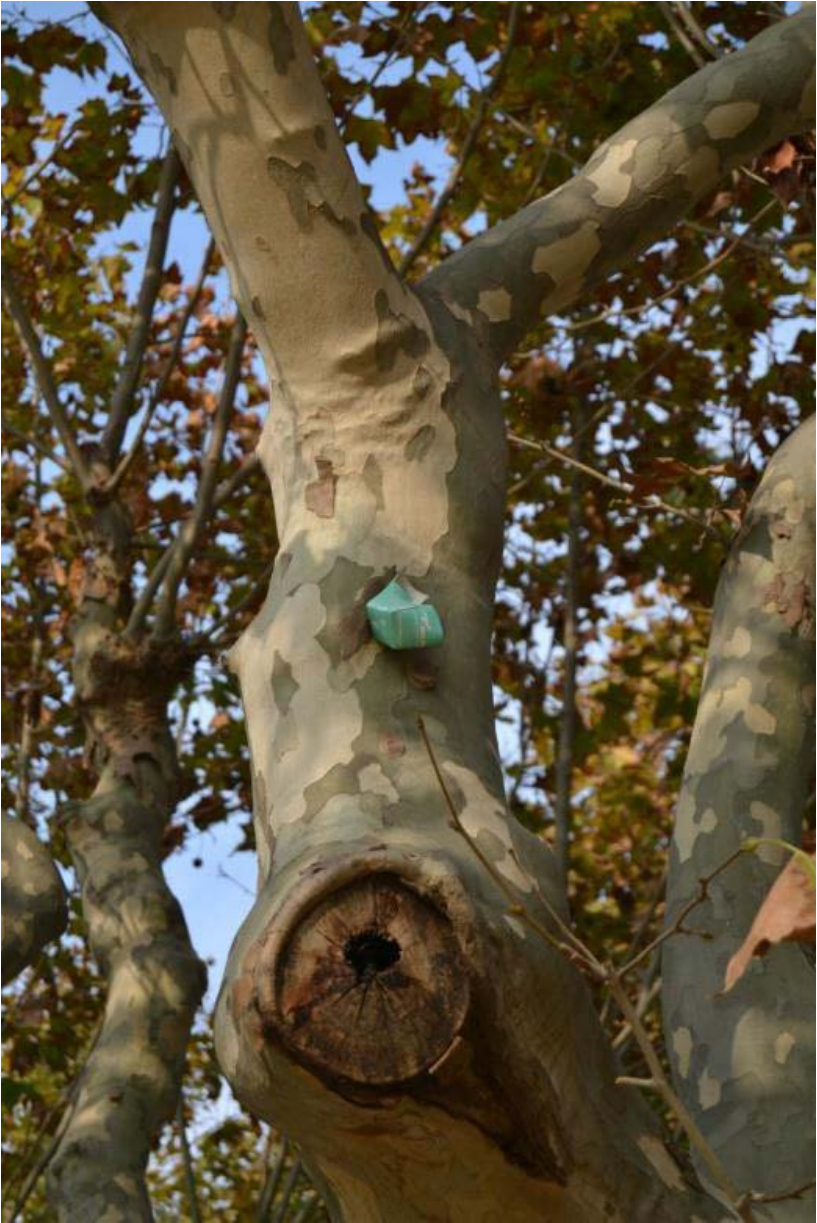
Tree pit with weeds

BIOLOGICAL CONTROL IN BARCELONA.

Alignment tree units treated	Species	Pest	Natural enemy	Effectiveness
5000	<i>Platanus x hispanica</i>	<i>Corythuca ciliata</i>	<i>Anthocoris nemoralis</i>	Average
9200	<i>Styphnolobium japonicum</i>	<i>Aphid</i> sp.	<i>Aphidius colemani</i>	High
2843	<i>Tipuana tipu</i>	<i>Platycorypha negrivrira</i>	<i>Anthocoris nemoralis</i>	Average
4725	<i>Robinia pseudoacacia</i>	<i>Aphid</i> sp.	<i>Aphidius colemani</i>	High
2927	<i>Cercis siliquastrum</i>	<i>Cacopsylla pulchella</i>	<i>Anthocoris nemoralis</i>	High
2673	<i>Jacaranda mimosifolia</i>	<i>Aphis gossypii</i>	<i>Aphidius colemani</i>	High
1407	<i>Tilia</i> sp.	<i>Eucallipterus tiliae</i>	<i>Aphidius colemani</i>	High
933	<i>Catalpa bignonioides</i>	<i>Aphid</i> sp.	<i>Aphidius colemani</i>	High
911	<i>Hibiscus syriacus</i>	<i>Aphis gossypii</i>	<i>Aphidius colemani</i>	High
Total 30619				

Data from the Tree Management Department in 2014. Green Spaces and Biodiversity Department. Barcelona City Council

Aphid (*Aphis catalpae*) next to a ladybird larva on a catalpa leaf. Photo: Xelo Ribes



Biological control for tackling the sycamore lace bugs (*Corythuca ciliata*)

BIODIVERSITY ASSOCIATED WITH TREES:
BIRDS AND MAMMALS

WOODPECKERS

Woodpeckers (Picidae family) are a group of birds that feed on trunks and branches (often on dead wood) and which build their nests by piercing trees with their powerful beaks. They can be observed scaling trunks and branches, although some species also go down to the ground in search of food. The main species of woodpecker we can observe in forest areas on the southern slope of the Collse-rola mountain are European green woodpeckers (*Picus viridis*). Note too the modest incursion that great spotted woodpeckers (*Dendrocopus major*) seem to have been making in the Parc del Laberint d’Horta over the last few years.

EUROPEAN GREEN WOODPECKER (*Picus viridis*)



Photo: Wikimedia

Features: This is a large build, some 30 cm long, notable for its greenish-coloured plumage. A red stripe appears on the crown of its head. It also has a moustache-shaped stripe with a red centre in males and a black centre in females.

Habitat: this is an ubiquitous species that occupies a large variety of tree habitats, from mature forests to open spaces with trees. The species prefers forests that have dead wood available and trees with softer wood for carving nests in, as it is not a good nest piercer. It accordingly prefers to carve out holes in weakened or dead Aleppo pine trees (*Pinus halepensis*) or trees with soft wood, such as poplars (*Populus nigra*) and aspens (*Populus tremula*).

Feeding: it feeds on a large quantity of insects it captures with its long and sticky tongue. It shows a predilection for ants and their larvae and eggs, although it also eats fruit and seeds. It often looks for food on the ground.

Behaviour: it has a characteristic sway to its flying and gives out a call that sounds like laughter. Its beak can be heard tapping away against trees, to carve out a nest, in the months of March and April. They usually change their nests every year.

Nest: entry holes to nests are some 6 cm in diameter.

Distribution: it is sedentary and nests in Catalonia.

TREECREEPERS AND TITS

These are all insectivorous birds incapable of carving out nests in tree trunks and are therefore dependent on old woodpecker nests and other hollows that trees offer them to nest in.

SHORT-TOED TREECREEPER (*Certhia brachydactyla*)



Photo: Wikimedia

Features: this is a brownish-colour bird whose distinctive trait is its fine, very long and slightly curved beak. Also notable are its toes, especially the back one, which is longer and used for getting a firm grip on tree trunks.

Habitat: it lives in every type of forest - including oak, pine and riparian woodlands - as well as in Barcelona's parks and gardens, provided there are old, rough-barked trees for searching for food on.

Feeding: every kind of insect and spider.

Behaviour: Presents a fairly curious form of food-searching behaviour, which it does between the bark and cracks of trunks, using its beak to capture food, starting from the bottom of the trunk and progressing upwards in helical movements all along the trunk. Once it has covered the entire main trunk, it flies down to the base of another nearby trunk.

Nest: it uses cracks and holes in tree trunks to house its nests, which are made of grass, roots, pieces of bark and feathers. It also occupies old European green woodpecker nests.

Distribution: it is sedentary and nests in Catalonia.

TITS

Tits (Paridae family) are small insectivorous forest birds that feed mainly from tree boughs, although some species feed from among shrubs and the ground too. They use a large variety of hollows for breeding and live in different environments. Even so, each species of tit has a preference for a particular type of forest. The European crested tit (*Lophophanes cristatus*) and coal tit (*Periparus ater*) live in pine forests, whereas the Eurasian blue tit (*Cyanistes caeruleus*) prefers oak, holm oak or mixed forests. The great tit (*Parus major*), by contrast, is the most generalist of all and can live in any type of forest.

GREAT TIT (*Parus major*)



Photo: Pau Núñez

Features: a bird that is unmistakable, thanks to the spectacular black strip that runs down its yellow chest and which is identifiably wider among males than females.

Habitat: it is the most generalist species of the family when it comes to habitat, although it does show a preference for forests that are not dense. The species can be seen in Barcelona, not just in its parks and gardens but also in its more urban areas, where there are mature lined trees with available hollows.

Feeding: it feeds on insects, especially cockroaches and spiders, as well as fruit in the winter. It also includes pine processionary (*Thaumetopoea pityocampa*) caterpillars in its diet.

Behaviour: its females apparently tend to mate with males that present plumages that are more spectacular in tone and intensity, which are indicators of a better quality diet and, therefore, of being in better health.

Nest: it builds nests in the shape of a small pot, made from moss, branches, down and other elements that the adults find, such as hair and wool threads, and places them in tree hollows or holes in stone walls. It readily accepts nest boxes with 30 mm wide holes (larger than the ones that the Eurasian blue tit uses).

Distribution: it is sedentary and nests in Catalonia.

EURASIAN BLUE TIT (*Cyanistes caeruleus*)



Photo: Guillem Pascual

Features: its tail, wings and crown are blue. It has a black stripe that crosses its eyes from the base of its beak to the back of its neck. Its cheeks are white. Its chest is yellow with a small longitudinal black stripe.

Habitat: it shows a preference for mixed or deciduous open woods, as found in Barcelona's parks and gardens.

Feeding: it feeds on insects and their larvae, spiders and even eats fleshy fruit.

Nest: it usually nests in tree hollows, although it normally nests in other substrates in urban settings, such as stone walls. It builds its nests from moss and feathers. It will live in a nest box where there are few holes and where entry holes have diameters measuring 27 mm.

Distribution: it is sedentary and nests in Catalonia.

EUROPEAN CRESTED TIT (*Lophophanes cristatus*)



Photo: Wikimedia

Features: it bears an unmistakable crest on its head which rises or drops when it is defending its territory or in a state of alert.

Habitat: it shows a preference for pine forests.

Feeding: it feeds on insects and spiders and supplements its diet with pine nuts outside the breeding season. It stores its food in tree-bark cracks.

Nest: it nests in tree hollows and builds its nests from hair, wool and feathers. It is a regular inhabitant of nest boxes, where they have entry holes measuring 28 mm in diameter.

Distribution: it is sedentary and nests in Catalonia.

COAL TIT (*Periparus ater*)



Photo: Wikimedia

Features: its head is black while the back of its neck and its cheeks are white.

Habitat: it can be seen in the woody areas of the city's parks and gardens, especially where there are pine trees.

Feeding: it is basically an insectivore that feeds on small cockroaches, wasps, bees and spiders, through it also eats pine seeds during the autumn and the winter. Its fine beak allows it to forage for food between pine needles and pine-cone scales, often with acrobatic twists and turns. It stores its food during the autumn in the tree-bark cracks, old nests, holes and other places, for use when there is a sharp fall in the quantity of food resources during the winter.

Nest: it builds its nests out of moss, hair and feathers in tree hollows and holes in stone walls. It can also use nest boxes where their entry holes have 25 mm diameters.

Distribution: it is sedentary and nests in Catalonia.

LONG-TAILED BUSHTIT (*Aegithalos caudatus*)



Photo: Wikimedia

Features: it has a small, round body with a disproportionately long, black and white tail.

Habitat: it lives in woody and shrubby areas and fruit-tree fields.

Feeding: it eats insects, spiders and seeds.

Nest: it builds its nests from lichens, moss and cobwebs and usually lines them with feathers. Its nests are balloon shaped with a small lateral entrance hole. It nests in shrubs and trees.

Distribution: it is sedentary and nests in Catalonia.

OWLS

This is the generic name for a group of nocturnal birds of prey that feed on small insects, micro-mammals and small birds. Notable owls in the city's woody areas include:

EURASIAN SCOPS OWL (*Otus scops*)



Photo: Wikimedia

Features: this is a small owl which, thanks to its mimetic brown- and grey-shaded plumage, is quite hard to spot.

Habitat: it can be found in different environments ranging from agricultural plains, mosaic spaces and forest areas. It nests in tree hollows and uses old woodpecker nest hollows.

Feeding: it feeds on insects.

Distribution: it is active in the summer and nests in Catalonia.

TAWNY OWL (*Strix aluco*).



Photo: Lluís Maria Güell

Features: this is an average-sized owl, with varied colouring, ranging from grey to reddish brown. In fact, its plumage goes through grey and red stages. It has black eyes.

Habitat: this is a nocturnal bird of prey that breeds and hunts mainly in the forest, though it also uses nearby open spaces for hunting. It breeds in mixed or deciduous forests, such as oak woods, large parks and gardens and avenue-aligned trees that offer suitable hollows. It can be seen in the evenings and, sometimes, while it rests

during the day, perched on a branch, as shown in the photo here taken of one on a glossy privet (*Ligustrum lucidum*) on Carrer de Verdi.

Feeding: it feeds mainly on small mammals (wood mice, shrews etc.,) and therefore plays a key role in regulating the populations of these animals. Even so, the species presents a relatively varied diet that includes small birds, frogs and various invertebrates.

Distribution: it is sedentary and nests in Catalonia.

TREE-CROWN BIRDS

Notable species we can find associated with trees include a whole series of **forest birds** that breed and feed in tree crowns, which provide them with the food they need: fruit, seeds and invertebrates. The following are examples of this group: wood pigeons (*Columba palumbus*), Eurasian collared doves (*Streptopelia decaocto*), common firecrests (*Regulus ignicapillus*) and common chaffinches (*Fringilla coelebs*). They all nest among the branches of trees or tall shrubs and build their nests from small branches in the shape of a pot, the sizes of which vary according to species. These forest birds are mainly insectivores, although fruit and seeds make up an important part of their diet during the autumn. Such is the case with the Eurasian jay (*Garrulus glandarius*), another typically forest bird, easy to spot and, above all, listen to as it gives out a characteristic alert call when a person approaches its territory. It belongs to the corvid family and has the distinctive habit during the autumn of burying acorns and other fruit in the land, creating small food reserves, that allow them to face the cold season when food is scarce. It does not always remember its food stores and therefore acts as a fruit-dispersing agent.



Wood pigeon (*Columba palumbus*). Photo: Xavier Ferrer



Male common chaffinch (*Fringilla coelebs*)



Eurasian collared dove (*Streptopelia decaocto*)



Jay (*Garrulus glandarius*). Photo: Wikimedia



Common firecrest (*Regulus ignicapilla*). Photo: Wikimedia



European serin (*Serinus serinus*). Photo: Xavier Ferrer



European greenfinch (*Carduelis chloris*). Photo: Wikimedia



European goldfinch (*Carduelis carduelis*). Photo: Wikimedia

Also worth noting are **finches**, a family of small birds with spectacular calls and plumage and which often nest in Barcelona's ornamental lined trees. They are granivores, that is, they feed on the grain and seeds of herbaceous plants from open spaces. Though they are associated with open spaces, they can easily be seen and their calls heard in the city's parks and gardens. The European goldfinch (*Carduelis carduelis*), the European greenfinch (*Carduelis chloris*) and the European serin (*Serinus serinus*) are just a few of the species that can be seen nesting in the crowns of trees of all sizes. They can be seen in the winter, feeding from the city's urban and peri-urban pasture, often forming fairly large groups.

TREE-ROOSTING BATS

COMMON PIPISTRELLA (*Pipistrellus pipistrellus*).

This is a fissure bat, as it seeks refuge in every kind of crack in houses, rocks, trees etc. It is commonly found in houses, behind shutters, roof tiles and rain pipes. It likes to hunt in woods, shrubby areas, parks and urban zones where it is frequently seen flying at night under the city's park and garden lamp posts. It is one of Europe's smallest bats, weighing between 4 kg and 7 kg.

SOPRANO PIPISTRELLE (*Pipistrellus pygmaeus*)

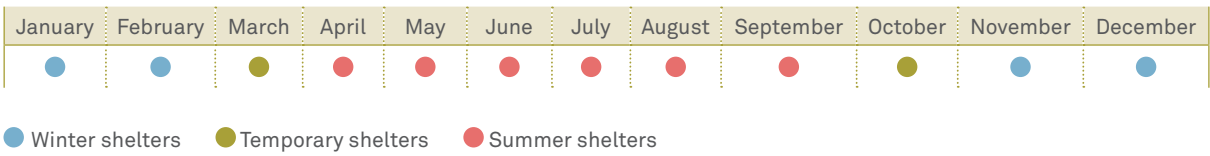
This is a fissure bat found in all types of buildings that can also easily be seen hunting small insects in parks and gardens, especially where there are ponds and pools. It is more usually found in the city than the common bat. It usually shelters not just in building cracks and fissures but also tree hollows where they hibernate.

KUHL'S PIPISTRELLE (*Pipistrellus kuhlii*)

It prefers to hunt in spaces full of trees or by street lamps, where many insects are attracted by their light. During the summer it shelters and breeds under tree bark, in tree hollows and cracks in buildings.

→ Annual bat cycle

Bats have an annual cycle that corresponds to the availability of food (insects) in the environment they develop in, and to the seasons. Males and females shelter temporarily in the autumn to mate. The female normally keeps its mate's sperm until the following spring, to start the process of gestation. During the winter, bats seek hibernation shelters where they will remain inactive for a long time. Bats leave their winter shelters during the spring, when temperatures start to rise. Females start moving to breeding or summer shelters, sometimes stopping at temporary shelters until they have located a final one for breeding. It is then that the ovule is fertilised and pregnancy begins, lasting between six and eight weeks. Males do not take part in the breeding process. The cycle starts again in the autumn.



OTHER MAMMALS ASSOCIATED WITH TREES

SQUIRREL (*Sciurus vulgaris*)



Photo: Josep Piqué

Features: also associated with trees are squirrels(-*Sciurus vulgaris*), which are tree-dwelling and active during the day.

Habitat: pine forests.

Feeding: it basically feeds on fruit and seeds, with pine nuts as its staple diet. Note here the role played by Aleppo pines (*Pinus halepensis*) as a large producer of pine nuts (practically throughout the year) which have a high caloric value.

Behaviour: with a bit of luck you can catch sight of a squirrel scaling a tree trunk or jumping from branch to branch. What is easy to find are the traces of gnawed pine cones that allow them to feed on their pine nuts.

It is worth knowing, however, how to distinguish pine cones that have been gnawed at by squirrels and wood mice (*Apodemus sylvaticus*), respectively. Where a cone is found with threads and a large number of scales around it, it's been nibbled by a squirrel. By contrast, if the entire cone has been gnawed at and no threads are left, the culprit is obviously a wood mouse, as it eats not only the pine nuts but also the scales.



Pine cones gnawed at by wood mice (*Apodemus sylvaticus*)

Nest: it builds spherical nests, covered in branches, leaves, moss and hair, which it positions on the branches of large trees.

Distribution: it can be seen in Barcelona on the pine trees in the rosengarden at the Parc de Cervantes, in the Jardins del Palau de Pedralbes, in the Parc del Putget, in the Parc del Castell de l'Oreneta and in the Laberint d'Horta.



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INTRODUCTION

Shrubby vegetation is typical of the Mediterranean region and very common in our country. It currently occupies over 400,000 hectares in Catalonia, according to data from the Department of Territory and Sustainability. This makes it the third-largest type of habitat, after (i) agricultural land and anthropogenic areas and (ii) coniferous forests. Shrubs are not usually over five metres high and their height can vary considerably. In fact, the types of shrub vegetation found are fairly diverse (scrublands, garrigues and maquis) and each has its own distinctive features. So, for example, scrubland covers the ground less when compared to maquis, which is denser. Bramble patches present more vertical development than scrublands. Shrub vegetation is found everywhere in urban areas, in squares, streets, parks and gardens, in all its varieties; such vegetation appears everywhere, for ornamental use — a prime example are rose bushes — but also for marking paths or separating spaces, whether in a park or on a public street. A clear example of this latter function — which coexists with the ornamental — are the hedges that can be seen along major avenues, such as Gran Via.

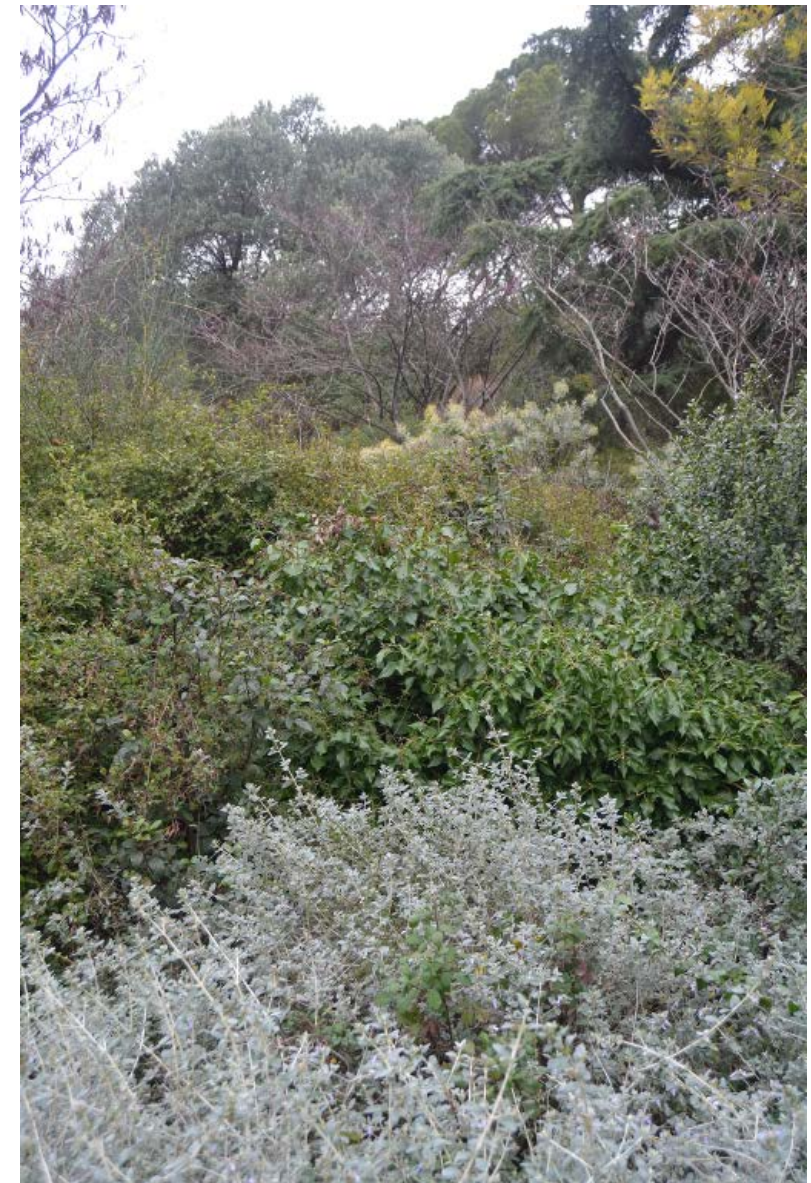
Authentic habitats

There are functions typical of a habitat besides the ones mentioned above. From this point of view, strengthening the shrub layer in parks and gardens has a direct impact on biodiversity. Besides providing a better structure and enriching the landscape mosaic, shrub vegetation acts as a green-area connector and offers nesting, sheltering and feeding places for insects and other invertebrates, small birds and mammals. It is precisely this large quantity of shrubs in the city which makes their contribution to biodiversity so important and, therefore, comparable to the role played by trees.

Because of its diversity, shrub vegetation allows numerous aesthetic combinations with contrasting forms, colours and aromas. Such combinations may also make places attractive to fauna. Rows or hedges made up of a single species are less attractive in that respect, but this can be compensated for with the introduction of fleshy-fruit species. For the general purposes of boosting biodiversity, it is advisable to avoid making spaces uniform and always ensure their potential for good diversity.

Firm but flexible criteria

Taking full advantage of the contribution made by shrubby groups and hedges to biodiversity requires the establishment of firm criteria for the organisation of their maintenance and improvement. However, such criteria have to be sufficiently flexible to adapt to the requirements of each space and species, given the heterogeneity of this plant group. Biodiversity as a goal is compatible with achieving environments with contrasting colours and aromas. A management of shrubby groups that takes account of all these aspects will enrich the urban environment all the more.



Parc del Turó del Putxet

Conserving the understorey to boost biodiversity and biological connectivity



Parc del Laberint d'Horta's understorey

Description/application

Made up of herbaceous and shrubby species, the understorey provides fauna with places for nesting, sheltering and feeding. It also plays an important ecological role, as it makes it easier for fauna to move about.

→ Understoreys do not generally have to be removed from forest spaces. Where a space presents considerable cover and action is decided on, selective pruning can be carried out from time to time, respecting a certain number of stems from the various shrub and liana species, so that the shrub layer is reduced to 30% or 40% (as a maximum) and to a height between 1 and 2 metres. The shrubby structure is therefore guaranteed. Sections are made stem by stem, so that the woody understorey is uniformly distributed throughout the area acted on. In any case, stronger pruning can concentrate on places with higher levels of human activity (beaten paths etc.) Fruit-bearing species need to be boosted.

→ It would be useful to carry out thorough scrub-clearing in the area of influence of these parks and gardens frequented by wild boars (*Sus scrofa*) and subject to the effects of their rummaging, for the purposes of removing the environment's shelter-providing shrubby cover and making it more difficult for such fauna to move to the garden areas. Likewise, for the purposes of fire protection and regulation compliance (Decree 123/2005), a 25-metre buffer strip has to be kept clear along the boundary between the city and Parc de Collserola.

Where there is a risk of fire, the number of more inflammable woody species must be reduced, including species of rockrose (*Cistus sp.*) and heather (*Erica sp.*) and generally all the species that contain essential oils and other volatile and inflammable compounds. By contrast, we have to boost the presence of dense-wood and high-heat capacity species that need to absorb considerable heat before they can catch fire, such as boxwood (*Buxus sempervirens*), mastic trees (*Pistacia lentiscus*), turpentine trees (*Pistacia terebinthus*), Mediterranean buckthorn (*Rhamnus alaternus*), black hawthorn (*Rhamnus lycioides*), flax-leaved daphne (*Daphne gnidium*), laurustinus (*Viburnum tinus*), Kermes oak (*Quercus coccifera*), common juniper (*Juniperus communis*), strawberry trees (*Arbutus unedo*), osyris (*Osyris alba*) and other shrubs.

→ One-off clearing and pruning, as well as selective cutting, should preferably be carried out during the winter and always avoid the nesting period of birds (spring). Consult Act 5/2003 on the prevention of forest fires, implemented under Decree 123/2005.

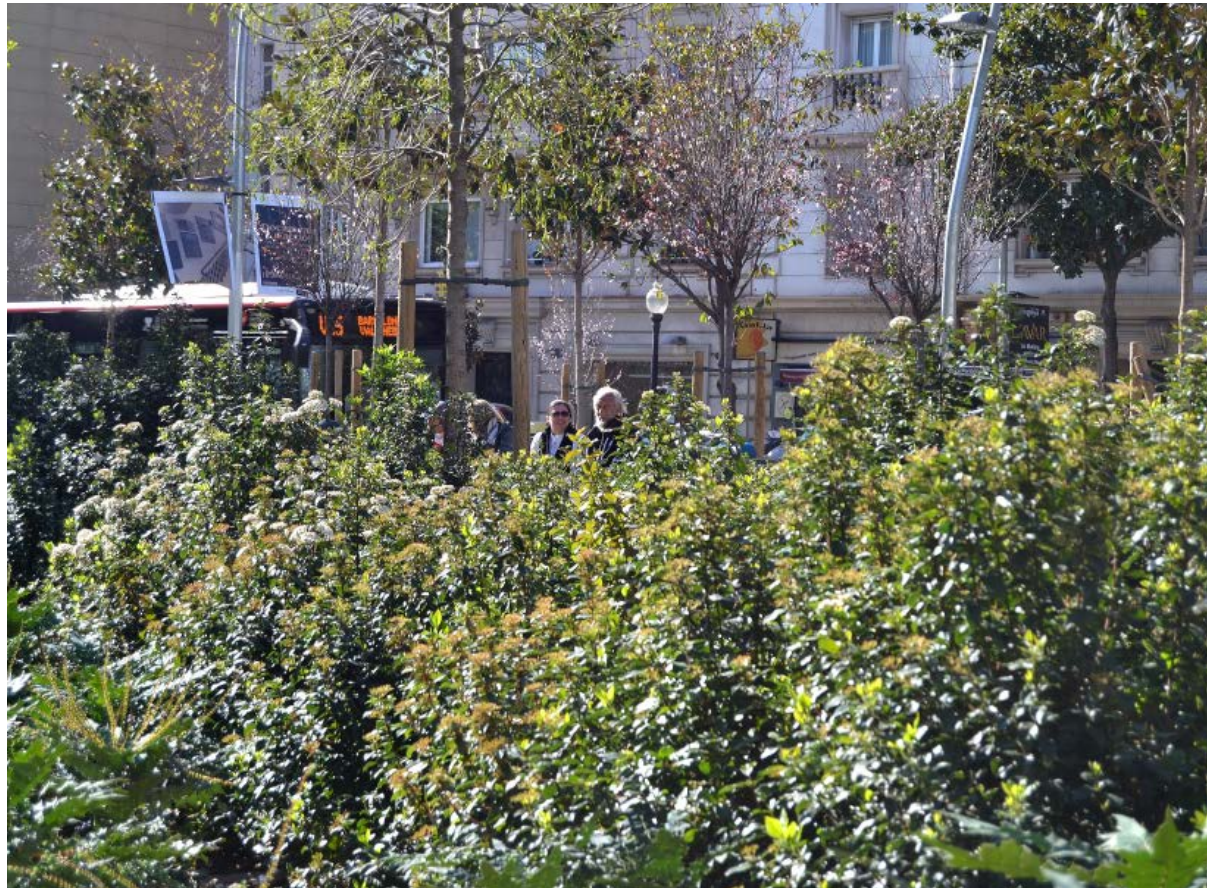


Heather (*Erica multiflora*)



Cistus clusii

Conservation of the natural size of shrubs *to boost the fauna's shelters and nesting*



Laurustinus (*Viburnum tinus*). Pl. Gal·la Placidia

Description/application

→ Enhancement pruning must be avoided to ensure shrubs maintain their natural sizes. Where these shrubs are located in walking areas or flower beds in which accumulated rubbish can be seen, one option may be to enhance the first line of shrubs and thereby make cleaning work easier.

→ Enhancement pruning has to be avoided.



Evergreen spindle (*Euonymus japonicus*)

→ Heavy pruning must be avoided.



Strawberry tree (*Arbutus unedo*)

Restricting the use of invasive plants *to prevent them from spreading in ecosystems*



Japanese mock orange
(*Pittosporum tobira*)

Description/application

Consider the list of invasive plants. (See *annexe 4: Study on invasive species in Barcelona and proposal for alternative species*) when it comes to taking decisions on renovating or creating a plantation. Some of these plants are listed in the Spanish catalogue of exotic and invasive species (Royal Decree 630/2013). Such is the case with summer lilac (*Buddleja davidii*) which, given its capacity to re-shoot and grow and ease of dispersal through seeds, creates problems on river banks in many places. It is true that summer lilacs attract a large number of butterflies due to the high content of their flowers, though their invasive behaviour and negative effects on natural communities must not be forgotten in any case.

Account should also be taken of the invasive potential of certain species which, while not listed as invasive plants, behave as such in certain places. Such is the case with Japanese mock orange (*Pittosporum tobira*) in Parc de Collserola. Their seeds feed song thrushes (*Turdus philomelos*), common blackbirds (*Turdus merula*) and other birds that act as seed-dispersing agents and contribute to the spread of the species through natural areas. We therefore need to avoid planting Japanese mock oranges and other plant species with invasive potential along the Barcelona buffer strip bordering the Parc de Collserola.



Summer lilac (*Buddleja davidii*)

Restricting the use of resinous species *to avoid acidifying the soil*



Mediterranean cypress hedge (*Cupressus sempervirens*)

Description/application

Restricting, in hedges or groups of shrubs, the presence of resin-producing species (cypresses and other conifers), which excessively acidify the soil and prevent the development of invertebrates among the litterfall.



Northern white-cedar hedge *Thuja occidentalis*



Accumulation of pine needles



Mastic tree hedge (*Pistacia lentiscus*)

Boosting the use of native species of flora *to attract local fauna*

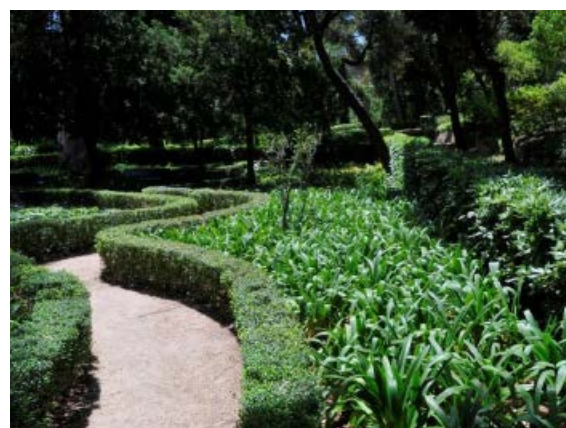


Can Mestres

Description/application

Hedges are usually made up of species such as cherry laurels (*Prunus laurocerasus*), evergreen spindle (*Euonymus japonicus*), Atlantic white cedar (*Thuja orientalis*), Japanese mock orange (*Pittosporum tobira*) and other shrubs often used in gardening for their dense and persistent foliage and resistance to frequent pruning. Even so, and as far as the associated biodiversity is concerned, it can be generically asserted that using native plant species allows greater interaction with a space's local fauna, so increasing the complexity of the ecosystem or habitat.

Irrespective of the species used, the shrubby structure is an important factor in its own right that has to be taken into account, as it offers nesting places for understorey birds, tree cover for the movement of fauna and litterfall accumulation areas.



Parc del Laberint d'Horta

→Strengthening the presence of birds:

Shrubs or hedgerows have to be chosen which bear fruit during the autumn-winter period, such as strawberry trees (*Arbutus unedo*), mastic trees (*Pistacia lentiscus*), laurustinuses (*Viburnum tinus*), elmleaf blackberry shrubs (*Rubus ulmifolius*), dog rose bushes (*Rosa canina*), evergreen rose bushes (*Rosa sempervirens*) and sweetbriar rose bushes (*Rosa rubiginosa*). The peak maturation period for these plants is during the autumn and winter, marking the arrival of migrant and winter birds, which have high energy requirements for tackling long migration periods and low temperatures. This fosters the availability of food for fruit-eating birds and many insectivores which change their diet during the cold season when low temperatures prevent the development of invertebrate species. All these fruits will be used by blackbirds, thrushes, robins, warblers and flycatchers. This is therefore about offering possibilities of feeding,

through fruiting, during a period in the year when there are few food resources. (See **annexe 4: Fruiting calendar**). At the same time, birds act as seed-dispersing agents of these types of fleshy fruit and therefore play an ecological role of the first order. So, blackbirds (*Turdus merula*) and robins (*Erithacus rubecula*), for example, are seed-dispersal agents of ivy, whose fruit constitutes a large part of their winter diet.

Understorey birds refer to a whole series of species that move through this shrub layer and use it for hiding their nests in and feeding on every type of invertebrate and fruit offered by the various species of shrubs and lianas found there. These notably include Sardinian warblers (*Sylvia melanocephala*), blackcaps (*Sylvia atricapilla*), Eurasian wrens (*Troglodytes troglodytes*), European robins (*Erithacus rubecula*) and blackbirds (*Turdus merula*). (See **annexe 2: Understorey birds and mammals**).



Elmleaf blackberries (*Rubus ulmifolius*)



Butcher's-broom fruit (*Ruscus aculeatus*)



Male blackbird (*Turdus merula*)



European robin (*Erithacus rubecula*). Photo: Wikimedia



Male and female Eurasian blackcaps (*Sylvia atricapilla*). Photo: Wikimedia



➔Strengthening the presence of butterflies:



The false ilex hairstreak (*Satyrium esculi*) uses the Kermes oak (*Quercus coccifera*) the holm oak (*Quercus ilex*) as its host plant



Cleopatra butterfly (*Gonepteryx cleopatra*)

Native shrubs have to be used, as a host plant for several species of butterflies. Strawberry trees (*Arbutus unedo*), for example, attract two-tailed pashas (*Charaxes jasius*), one of the most spectacular of our fauna and considered Europe's largest diurnal butterfly. A fluorescent green crossed by a lateral yellow line on both sides of the body and a head with four horn-like protuberances are the hallmarks of its caterpillar, which feeds exclusively on strawberry tree leaves. The Mediterranean buckthorn (*Rhamnus alaternus*) is another example of shrub that is used as a host plant for the Cleopatra butterfly (*Gonepteryx cleopatra*) and the common brimstone (*Gonepteryx rhamni*). (See **Courtyards, small gardens, balconies, terraces and green roofs. Annexe 2: Diurnal butterflies**).



Two-tailed pasha adult and caterpillar (*Charaxes jasius*). Photo: Wikimedia



Strawberry tree flowers and fruit (*Arbutus unedo*)

➔Strengthening the pollinating insects:



Elongated bean weevil (*Lixus algerius*)



Grey-leaved cistus (*Cistus albidus*)



Collserola allotment Laurustinus, rosemary and lavender.



Hummingbird hawk-moth (*Macroglossum stellatarum*) sipping from lavender flowers



Flowering sweet bay tree (*Laurus nobilis*)



Flowering laurustinus (*Viburnum tinus*)



Flowering common dogwood (*Cornus sanguinea*)

Use will be made of plants such as rockrose (*Cistus sp.*) and shrubby hare's ear (*Bupleurum fruticosum*) and aromatics such as thyme (*Thymus vulgaris*), rosemary (*Rosmarinus officinalis*) and lavender (*Lavanda officinalis*), whose high nectar-content flowers coat pollinating insects with large amounts of pollen. Rose bushes (*Rosa sp.*) are also very attractive to fauna, especially when they are wild species bearing simple rather than double flowers, as they provide pollinating insects with access to the flowers' nectar. (**See Grasses, fields and grasslands. Annexe 3: Beekeeping flora**). Their fruit provides food for birds.



Dog-rose (*Rosa canina*) flower and fruit

➔ It is also advisable to boost shrub layers in the periphery of parks and gardens as feeding and shelter places and as green-area connectors, using high-value ecological and perhaps less aesthetic species. Bramble bushes deserve special attention, often little appreciated and at the wrong end of maintenance work, but very useful given that they bear fruit and shelter insects and invertebrates in general, as well as understory birds and mammals, such as the common or European hedgehog (*Erinaceus europaeus*). Boosting the presence of species in green areas, such as elmleaf blackberries (*Rubus ulmifolius*), means working towards a better structure of the landscape mosaic, by ensuring, at the same time, shelter and food for many groups of fauna.



Palau Reial's shrubby area



Bramble bushes in the Can Cadena's allotments

Boosting the presence of litterfall and other fauna shelters to boost biodiversity



Cross spider (*Araneus diadematus*), commonly found in gardens

Description/application

→ It is advisable not to remove litterfall from less visited garden areas, so invertebrate fauna can develop. Note that invertebrates are at the bottom of the food chain and therefore play a key role in enabling insectivores to feed. They also help to incorporate organic material into the soil, by closing the cycle of elements.

→ Shrub borders require mulching so habitats can be created for invertebrates.



→ Shrub-pruning needs to be carried out in more remote forest areas, to build up small piles of trunks, branches and litterfall, one or two metres in diameter and roughly one metre in height. Such accumulations will be distributed throughout the area acted on at a density free of fire risks. Shelters and feeding places are thereby created for invertebrates, wood mice (*Apodemus sylvaticus*) and other small mammals, such as the common or European hedgehog (*Erinaceus europaeus*) and understorey birds, by making up for the loss of understorey wood. It is also advisable to put empty trunks or stones between shrubby vegetation, creating holes and spaces inside them.



Adapting maintenance work to the natural cycles of flora and fauna to prevent interference in their development



Mastic tree (*Pistacia lentiscus*)

Description/application

→ The biological cycles of these important shrubs need to be respected, from the perspective of their fruiting, as they provide food for fauna.

→ Shrub-group and hedge pruning should be concentrated on during the winter period (from December to February). Otherwise, some birds could be prevented from breeding. The goal is to avoid such pruning coinciding with the birds' spring nesting season.



Pruning Japanese mock orange (*Pittosporum tobira*)



Jardins de Rubió i Tudurí



Laberint d'Horta



Jardí dels Boixos. Laberint d'Horta

→ Entire shrubby areas should not be pruned within the same year, to allow the presence of shrubs at different development stages and shelter spaces for several species at all times.

→ Border-maintenance pruning needs to be carried out once a year (between October and February) and shrub shape-pruning just once during the winter period.

All these issues can be dealt with under a maintenance plan that establishes the guidelines that have to be followed in each case and which necessarily have to be compatible with the ornamental criteria for each place.

Creating mixed hedges *to boost biodiversity*



Laurustinus, shrubby germander and mastic-tree shrub border

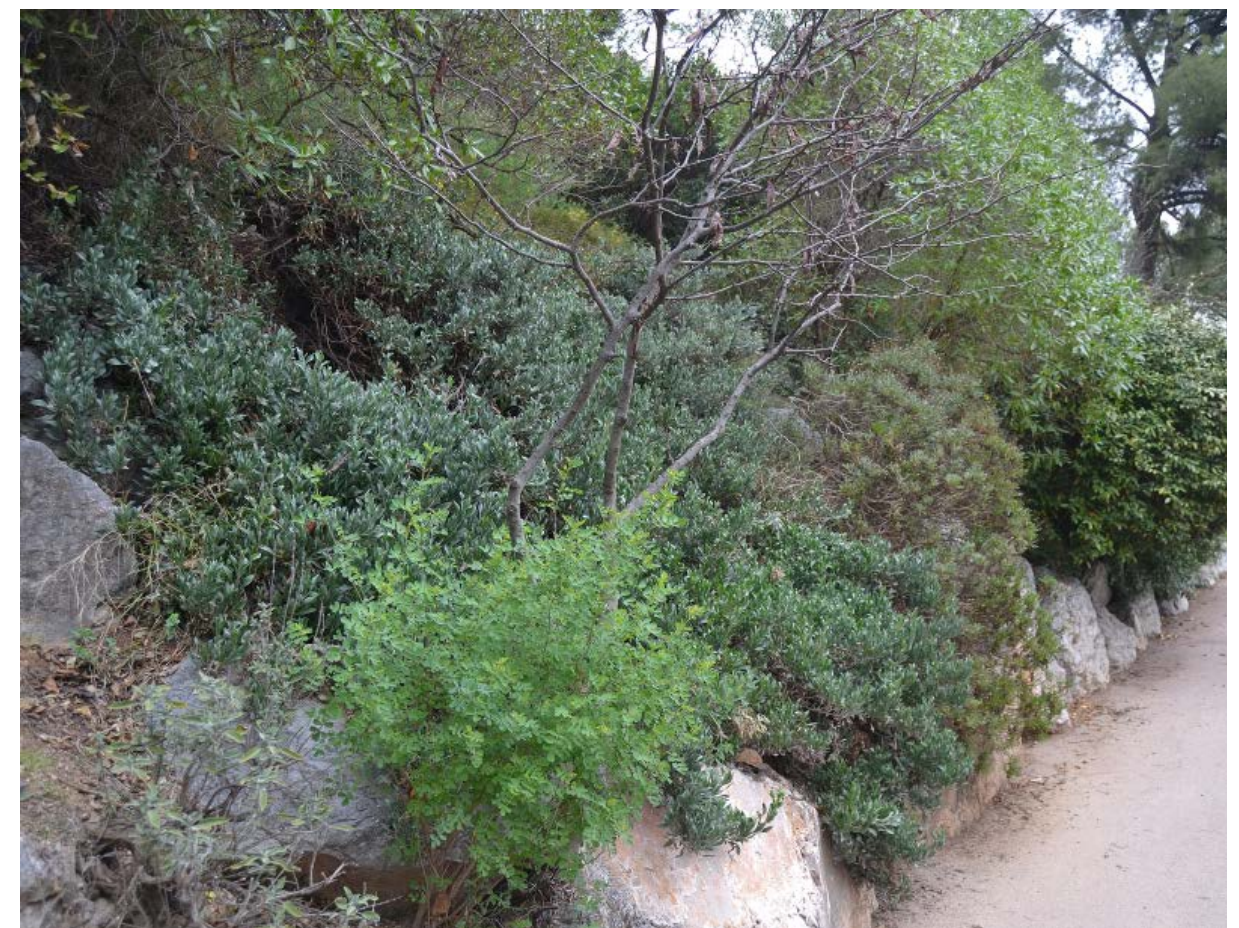
Description/application

→ Consideration should be given to using several shrubby species for shaping mixed hedges, as they are most like the shrub borders found in a natural wood. Such hedges attract greater diversity of fauna.

→ If single-species hedges typical of the ones used in gardening are to be created, a shrub species should be considered that is useful for fauna, such as the strawberry tree (*Arbutus unedo*), the mastic tree (*Pistacia lentiscus*), the sweet bay tree (*Laurus nobilis*) and laurustinus (*Viburnum tinus*). It is important in such cases for the associated pruning work to respect the flowering and fruiting cycles of the species used, by making use of a quality shrub layer.

→ Using alien species with a long tradition in ornamental gardening for creating such hedges is to be preferred in parks and gardens where types and ornamental criteria are associated with thorough pruning-related maintenance. Native plants undergoing thorough

and ongoing pruning do not offer the aesthetic results expected for such cases. Evergreen spindle (*Euonymus japonicus*), Korean privet (*Ligustrum ovalifolium*), shrubby germander (*Teucrium fruticans*), cherry laurel (*Prunus laurocerasus*), thorny olive (*Elaeagnus pungens*), crimson spire (*Escallonia rubra*) and others are a good alternative. So, if shrubby hedges are to be created with native plants, their natural flowering and fruiting cycles and natural sizes should be respected as much as possible. (See **annexe 3: Shrubby plant of use to fauna**).



Coronilla, *Limoniastrum monopetalum* and laurustinus shrub border.

Hedge vegetation for boosting diversity



Minorca honeysuckle (*Lonicera implexa*) flowers

Description/application

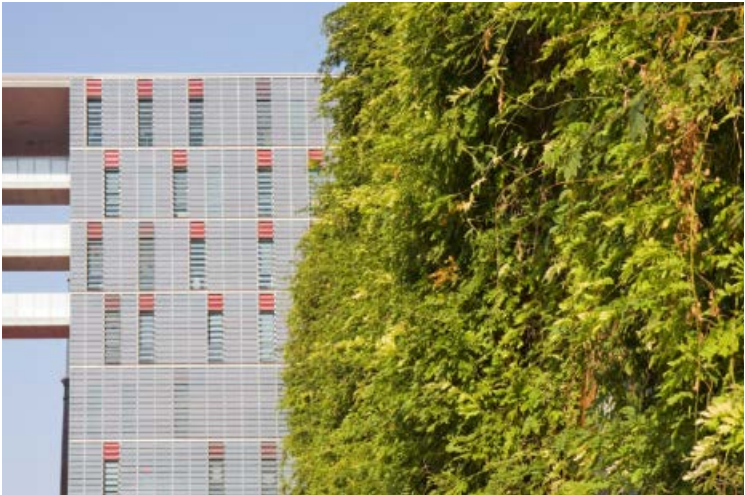
→ Heather and reed dry hedges and even metal fences can be covered with climbing plants, to make them more useful for fauna. (See *annexe 4: Climber-plant and hedgerow fruiting calendar*).



Minorca honeysuckle (*Lonicera implexa*) fruit



Wall covered with creeping fig (*Ficus repens*)



Wall covered with Chinese wisteria (*Wisteria sinensis*)



Wall covered with Australian native wisteria (*Hardenbergia comptoniana*)

LIST OF INVASIVE SPECIES

Source: “Study on invasive species in Barcelona and suggestion for alternative species”. Consult the study on the corporate website:
<http://cort.as/d1YE>

Scientific name	Common name
<i>Acacia dealbata</i>	Silver wattle
<i>Acacia saligna</i>	Coojong
<i>Acer negundo</i>	Box elder
<i>Agave americana</i>	American aloe
<i>Ailanthus altissima</i>	Tree of heaven
<i>Aloe maculata</i>	Soap aloe
<i>Araujia sericifera</i>	Moth plant
<i>Arundo donax</i>	Giant cane
<i>Azolla</i> sp.	
<i>Buddleja davidii</i>	Summer lilac
<i>Carpobrotus edulis</i>	Hottentot-fig
<i>Carpobrotus acinaciformis</i>	Elands Sourfig
<i>Cortaderia selloana</i>	Pampas grass
<i>Cotoneaster lacteus</i>	Milkflower cotoneaster
<i>Cotoneaster pannosus</i>	Silverleaf cotoneaster
<i>Cylindropuntia</i> sp.	
<i>Cyperus involucratus</i>	Umbrella sedge
<i>Eschscholzia californica</i>	California poppy
<i>Fallopia baldschuanica</i>	
<i>Gomphocarpus fruticosus</i>	Milkweed
<i>Helianthus tuberosus</i>	Jerusalem artichoke
<i>Ipomoea indica</i>	Blue morning glory

Scientific name	Common name
<i>Lantana camara</i>	Wild-sage
<i>Ligustrum lucidum</i>	Glossy privet
<i>Lonicera japonica</i>	Japanese honeysuckle
<i>Nicotiana glauca</i>	Tree tobacco
<i>Opuntia aurantiaca</i>	
<i>Opuntia dillenii</i>	
<i>Opuntia ficus-indica</i>	Prickly pear
<i>Opuntia maxima</i>	
<i>Opuntia stricta</i>	
<i>Parthenocissus quinquefolia</i>	Virginia creeper
<i>Parthenocissus tricuspidata</i>	Boston Ivy
<i>Pennisetum villosum</i>	Feathertop grass
<i>Phytolacca americana</i>	American pokeweed
<i>Pittosporum tobira</i>	Japanese mock orange
<i>Prunus laurocerasus</i>	Cherry laurel
<i>Phyracantha angustifolia</i>	Narrowleaf firethorn
<i>Robinia pseudoacacia</i>	Black locust
<i>Senecio angulatus</i>	Creeping groundsel
<i>Senecio inaequidens</i>	South African ragwort
<i>Senecio mikanioides</i>	
<i>Senecio pterophorus</i>	

UNDERSTOREY BIRDS AND MAMMALS

These are birds and mammals that use shrub layers for finding shelter, nesting places and food, such as the small invertebrates and fruit they are provided by the various species of shrubs and lianas.

WARBLERS, CHIFFCHAFFS AND WRENS

Warblers are the group of birds most directly linked to shrub layers. They carry out most of their activity between the branches of shrubs and bramble bushes, where these offer them sufficient cover to find places for nesting and feeding on invertebrates. Because of their discreet behaviour they can usually only be located by their call. Notable species in the urban and peri-urban environments include the following:

Male Eurasian blackcap



EURASIAN BLACKCAP (*Sylvia atricapilla*)



Features: males and females are easily recognised by their respective black and brownish-red crowns (caps).

Habitat: they live in woody areas that have an abundant shrub understorey. Common too in the city's parks and gardens.

Feeding: they are insectivores, although they will supplement their diet with fruits of the forest in autumn and winter, when there are few invertebrates available.

Distribution: they are considered sedentary nesters in Catalonia, although their population numbers rise in the winter with the arrival of individuals from central and northern Europe in search of milder temperatures for spending the cold season.

SARDINIAN WARBLER (*Sylvia melanocephala*)



Features: the species presents discreet colours, a long tail and, perhaps most distinctively, an outer bright-red ring around its eyes.

Habitat: they can be found on cultivated land, brushwood scrub, hedges and pine groves, wherever there are well-developed shrubs. Common in the city's parks and gardens.

Feeding: they eat invertebrates (cockroaches, worms, flies, butterflies and spiders) in the spring and summer and feed on fruits of the forest in the autumn and winter.

Distribution: they are considered sedentary nesters in Catalonia, although their population numbers rise in the winter with the arrival of individuals from central and northern Europe.

COMMON CHIFFCHAFF (*Phylloscopus COLLYBITA*)



Features: it is a small greenish-brown bird with a white breast. It bears a distinctive eyebrow-shaped white stripe above its eyes. It has a short tail and dark feet.

Habitat: it prefers humid deciduous woods that have well-developed shrubs for nesting in. It is therefore found in Catalonia as a nester in the country's humid areas. In the winter, however, a large number of individuals come over from central or northern Europe, who are less demanding when it comes to

habitat and are, therefore, easily spotted in the city's parks and gardens.

Feeding: insects and spiders that it finds among the leaves and branches of trees and shrubs.

Distribution: it is a sedentary nester in Catalonia (in humid areas).

EURASIAN WREN (*Troglodytes troglodytes*)



Photo: Wikimedia

Features: it is a small brownish bird noted for its short tail, which it normally keeps raised. It is highly active and can be seen moving up and down the branches of shrubs, hiding between their leaves, only to resurface again in search of small insects.

Habitat: it lives in shrubby and woody areas and in gardens. It uses piled-up abandoned branches either for searching for food in or building its nests with.

Nest: it lives in shrubs or holes in walls. The male builds several nests from moss, grass and leaves, one of which the female chooses and lines with feathers to begin the breeding process.

Feeding: it eats insects, larvae, spiders and small seeds.

Distribution: they are considered sedentary nesters in Catalonia, although their population numbers rise in the winter with the arrival of individuals from central and northern Europe.

ROBINS AND BLACKBIRDS

Some species of understorey birds also use the tree layer or ground as a supplement for feeding on worms, caterpillars, snails and spiders.

EUROPEAN ROBIN (*Erithacus rubecula*)



Features: it is a small, round bird that is notable for its orange face and breast. It is easily spotted, given its confident behaviour around humans, which corresponds to the territorial nature that the species presents throughout the year. During the winter, males and females defend their feeding grounds with calls to mark out their territory. By contrast, during the spring, it is mainly the males that call out, to attract females and deter other males from occupying their territory, a message they reinforce by displaying their orange breasts. The intensity of the orange corresponds to the individual's dominance.

Habitat: it lives in humid woods and can also be seen in the city's allotments, parks and gardens, wherever there are humid spots with hedges and bare land for feeding.

Nest: in holes in stones or tree hollows.

Feeding: insects, earthworms, fruit and food leftovers.

Distribution: it is sedentary and nests in Catalonia. Many robins come over from central and northern Europe during the winter.

BLACKBIRD (*Turdus merula*)



Features: males are black with a yellow beak and yellow circle around their eyes, whereas female are brownish (without any yellow in their beak or around their eyes).

Habitat: it lives in humid woods and is very frequently found in the city’s parks and gardens, where it can be easily spotted walking and jumping abruptly in search of food. In fact, it is a highly ubiquitous species that also occupies cultivated land

and open areas with scrubland, shrubs and trees.

Nest: it builds it from soil and small branches on the branches of tall shrubs or small trees. It is shaped like a wide cup.

Feeding: an omnivorous bird, it feeds on insects, snails, fruit, food leftovers etc. Even so, it shows a preference for earthworms, making it easy to spot on grass lawns, especially where they have been recently watered, when earthworms are forced to come up to the surface to breathe.

Distribution: it is sedentary and nests in Catalonia. Blackbird population numbers rise in the winter, with the arrival of individuals from central and northern Europe. Blackbird population numbers rise in the winter, with the arrival of individuals from central and northern Europe.



MAMMALS

COMMON OR EUROPEAN HEDGEHOG (*Erinaceus europaeus*)



Photo: Sergi Garcia

Habitat: this is a nocturnal insectivorous mammal that lives in areas with a good herbaceous or shrubby cover, offering it opportunities for moving about, feeding and nesting in. Humid forest borders with shrubby cover make ideal places for this species. In this regard, structural heterogeneity becomes a key element for its development, with hedges and herbaceous perennials near to woody areas being especially important. Stone walls and water points are other determining factors for the establishment of this small mammal.

Feeding: mainly on small invertebrates, such as snails, worms, slugs and cockroaches, although it will not miss an opportunity to eat food leftovers, cat food and dog food.

Nest: it is spherical and made from grass, straw, hair and other elements it finds. It usually builds its nest under tree trunks and stones or in dense bramble bushes. It uses accumulated branches for nesting in.

Location: note the presence of hedgehogs in the Parc de la Ciutadella, the Laberint d’Horta and the Palau de les Hores.



Common or European hedgehog (*Erinaceus europaeus*). Photo: Sergi Garcia



Hedgehog in defensive strategy. Photo: Sergi Garcia

SHRUBBY PLANT OF USE TO FAUNA

Scientific name	Common name	Sunshine	Flowering	Nectariferous	Fruit	Host plant
<i>Anthyllis cytisoides</i>	N/A	Sunshine	Sp/Sm	Yes	No	
<i>Arbutus unedo</i>	Strawberry tree	Sunny/semi-shaded	A/W	Yes	Yes	Two-tailed pasha
<i>Bupleurum fruticosum</i>	Shrubby hare's ear	Sunshine	Sp/Sm	Yes	No	Average
<i>Buxus sempervirens</i>	Boxwood	Indifferent	Sp	Yes	Yes	High
<i>Calluna vulgaris</i>	Common heather	Sunshine	Sm/A	Yes	No	
<i>Cornus sanguinea</i>	Common dogwood	Semi-shaded	Sp	Yes	Yes	
<i>Crataegus monogyna</i>	Common hawthorn	Indifferent	Sp	Yes	Yes	Scarce swallowtail
<i>Erica arborea</i>	Tree heath	Sunny/semi-shaded	W/Sp	Yes	No	
<i>Erica multiflora</i>	Heather	Sunshine	A/W	Yes	No	
<i>Ilex aquifolium</i>	Common holly	Indifferent	Sp/Sm	Yes	Yes	
<i>Juniperus communis</i>	Common juniper	Sunny/semi-shaded	Sp	No	Yes	
<i>Juniperus oxycedrus</i>	Prickly juniper	Sunshine	W/Sp	No	Yes	
<i>Juniperus phoenicea</i>	Phoenician juniper	Sunshine	W/Sp	No	Yes	
<i>Laurus nobilis</i>	Sweet bay	Semi-shaded	Sp	Yes	Yes	
<i>Lonicera implexa</i>	Minorca honey-suckle	Sunny/semi-shaded	Sp	Yes	No	Yes
<i>Ligustrum vulgare</i>	Common privet	Sunny/semi-shaded	Sp/Sm	Yes	Yes	
<i>Lycium europaeum</i>	Box-thorn	Sunshine	Sp/Sm	Yes	Yes	
<i>Myrtus communis</i>	Common myrtle	Sunny/semi-shaded	Sp/Sm	No	Yes	
<i>Ononis natrix</i>	Yellow rest-harrow	Sunshine	Sp/Sm	Yes	No	
<i>Phillyrea angustifolia</i>	False olive tree	Sunny/semi-shaded	Sp	No	Yes	

Scientific name	Common name	Sunshine	Flowering	Nectariferous	Fruit	Host plant
<i>Phillyrea latifolia</i>	Mock privet	Sunny/semi-shaded	Sp	No	Yes	
<i>Pistacia lentiscus</i>	Mastic tree	Indifferent	Sp	Yes	Yes	
<i>Prunus spinosa</i>	Blackthorn	Sunshine	W/Sp	Yes	Yes	
<i>Quercus coccinea</i>	Scarlet oak	Sunshine	Sp	Pollen	Yes	
<i>Rhamnus alaternus</i>	False olive	Indifferent	Sp	Pollen	Yes	Cleopatra Butterfly Common brimstone
<i>Rhamnus lycioides</i>	Black hawthorn	Sunshine	Sp	No	Yes	
<i>Rosa canina</i>	Dog-rose	Sunny/semi-shaded	Sp	Yes	Yes	
<i>Rosa sempervirens</i>	Evergreen rose	Sunny/semi-shaded	Sp	Yes	Yes	
<i>Rubus idaeus</i>	Red raspberry	Semi-shaded	Sp/Sm	Yes	Yes	
<i>Rubus ulmifolius</i>	Elmleaf blackberry	Sunshine	Sp	Yes	Yes	Yes
<i>Ruscus aculeatus</i>	Butcher's-broom	Semi-shaded	Sp	No	Yes	
<i>Sambucus nigra</i>	Elderberry	Sunny/semi-shaded	Sp	Yes	Yes	
<i>Sarothamnus scoparius</i>	Scotch broom	Sunshine	Sp	Yes	No	
<i>Spartium junceum</i>	Spanish broom	Sunshine	Sp	Yes	No	Pea blue
<i>Ulex parviflorus</i>	Gorse	Sunshine	Sp	Pollen	No	Yes
<i>Viburnum tinus</i>	Laurustinus	Sunny/semi-shaded	W/Sp	Yes	Yes	
<i>Vitex agnus-castus</i>	Chaste tree	Sunny/semi-shaded	Sp/Sm	Yes	No	

Sp = spring, Sm = Summer, A = autumn, W = winter

SHRUBBY SCRUBS OF USE TO FAUNA

Scientific name	Common name	Sunshine	Flowe- ring	Nectarife- rous	Host plant
<i>Aster sedifolius</i>	Michaelmas daisy	Sunshine	A	Yes	
<i>Asparagus acutifolius</i>	Wild asparagus	Sunshine	E	Yes	
<i>Cistus albidus</i>	Grey-leaved cistus	Sunshine	Sp	Pollen	Green hairstreak
<i>Cistus monspeliensis</i>	Montpellier cistus	Sunshine	Sp	Pollen	
<i>Cistus salviifolius</i>	Sage-leaved rock- rose	Sunshine	Sp	Pollen	Green hairstreak
<i>Dorycnium pentaphyllum</i>	Prostrate Canary clover	Sunshine	Sp/Sm	Yes	
<i>Globularia alypum</i>	Globe daisy	Sunshine	Sp	Yes	Scarce swallowtail
<i>Helichrysum italicum</i>	Curry plant	Sunshine	E	Yes	
<i>Helichrysum stoechas</i>	Curry plant	Sunshine	E	Yes	
<i>Hyssopus officinalis</i>	Hyssop	Sunshine	Sm/A	Yes	
<i>Lavandula angustifolia</i>	Common lavender	Sunshine	E	Yes	
<i>Lavandula stoechas</i>	Spanish lavender	Sunshine	Sp	Yes	
<i>Lithospermum fruticosum</i>	Shrubby gromwell	Sunshine	Sp	Yes	
<i>Marrubium vulgare</i>	Japanese mock orange	Sunshine	Sp/A	Yes	
<i>Melissa officinalis</i>	Lemon balm	Sunshine/ shade	Sp/Sm	Yes	
<i>Origanum vulgare</i>	Orenga	Sunshine	Sp/Sm	Yes	
<i>Phlomis herba venti</i>	Rough-leaved Jeru- salem sage	Sunshine	Sp/Sm	Yes	
<i>Rosmarinus officinalis</i>	Rosemary	Sunshine	Sp/S/A	Yes	Lang's short-tailed blue
<i>Ruta chalapensis</i>	Fringed rue	Sunshine	Sp/Sm	Yes	Southern scarce swallowtail
<i>Salvia officinalis</i>	Sage	Sunshine	Sp	Yes	
<i>Santolina chamaecyparissus</i>	Cotton lavender	Sunshine	Sp/Sm	Yes	
<i>Satureja calamintha</i>	Lesser Calamint	Sunshine	Sm/A	Yes	
<i>Satureja montana</i>	Winter savory	Sunshine	E	Yes	
<i>Thymus vulgaris</i>	Common thyme	Sunshine	W/Sp	Yes	Panoptes blue
<i>Thymelaea tinctoria</i>	Sparrowwort	Sunshine	W/Sp	Yes	

Sp = spring, Sm = Summer, A = autumn, W = winter



Aromatic plants in Park Güell



Cotton lavender (*Santolina chamaecyparissus*)

SHRUB FRUITING CALENDAR

Scientific name	Common name	Ja-nuary	Fe-bruary	March	April	May	June	July	August	Septem-ber	October	Novem-ber	Decem-ber
<i>Arbutus unedo</i> *	Strawberry tree	●									●	●	●
<i>Buxus sempervirens</i>	Boxwood					●	●	●					
<i>Cornus sanguinea</i>	Common dogwood								●	●			
<i>Crataegus monogyna</i> *	Common hawthorn									●	●	●	
<i>Ilex aquifolium</i>	Common holly	●								●	●	●	
<i>Juniperus communis</i>	Common juniper										●	●	●
<i>Juniperus oxycedrus</i>	Prickly juniper										●	●	●
<i>Juniperus phoenicea</i>	Phoenicean juniper									●	●	●	
<i>Laurus nobilis</i>	Sweet bay									●	●	●	
<i>Lycium europaeum</i>	Box-thorn										●	●	
<i>Myrtus communis</i>	Common myrtle									●	●	●	
<i>Phillyrea angustifolia</i>	False olive tree									●	●	●	
<i>Phillyrea latifolia</i>	Mock privet										●	●	
<i>Pistacia lentiscus</i>	Mastic tree									●	●	●	●
<i>Prunus spinosa</i>	Blackthorn								●	●	●	●	
<i>Quercus coccinea</i>	Scarlet oak								●	●	●	●	
<i>Rhamnus alaternus</i> *	False olive					●	●	●	●				
<i>Rhamnus lycioides</i>	Black hawthorn								●	●	●		
<i>Ruscus aculeatus</i>	Butcher's-broom	●									●	●	●
<i>Sambucus nigra</i>	Elderberry							●	●	●			
<i>Viburnum tinus</i>	Laurustinus	●								●	●	●	●

*Butterfly host plant. Approximate fruiting ranges.

CLIMBER-PLANT AND HEDGEROW FRUITING CALENDAR

Scientific name	Common name	Ja-nuary	Fe-bruary	March	April	May	June	July	August	Septem-ber	October	Novem-ber	Decem-ber
<i>Asparagus acutifolius</i>	Wild asparagus									●	●		
<i>Clematis vitalba</i>	Old man's beard									●	●	●	
<i>Hedera helix</i>	Common ivy	●	●									●	●
<i>Lonicera implexa</i>	Minorca honeysuckle									●	●	●	
<i>Rosa canina</i>	Dog-rose									●	●	●	
<i>Rosa sempervirens</i>	Evergreen rose									●	●	●	●
<i>Rubia peregrina</i>	Wild madder										●	●	
<i>Rubus ulmifolius</i>	Elmleaf blackberry									●	●	●	
<i>Smilax aspera</i>	Rough bindweed											●	●
<i>Vitis vinifera</i>	Common grape vine									●	●		



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INTRODUCTION

“Lawns” refer to dense and uniform covers made up of a series of species of grasses or legumes or a mixture of both, that people tend to mow from time to time. Made up of several herbaceous species, fields are less intensely maintained and are associated with less frequent mowing and clearing than lawns. When tall and leafy herbaceous species appear in a field, it is referred to as a grassland, which is associated with very low maintenance. Therefore, depending on the maintenance they receive, lawns can evolve into fields and grasslands. Open spaces such as fields and grasslands are extremely valuable for biodiversity, as they are a habitat with a large quantity of invertebrates at the bottom of the food chain for many groups of fauna. Their presence is diminishing in both cities and natural environments.

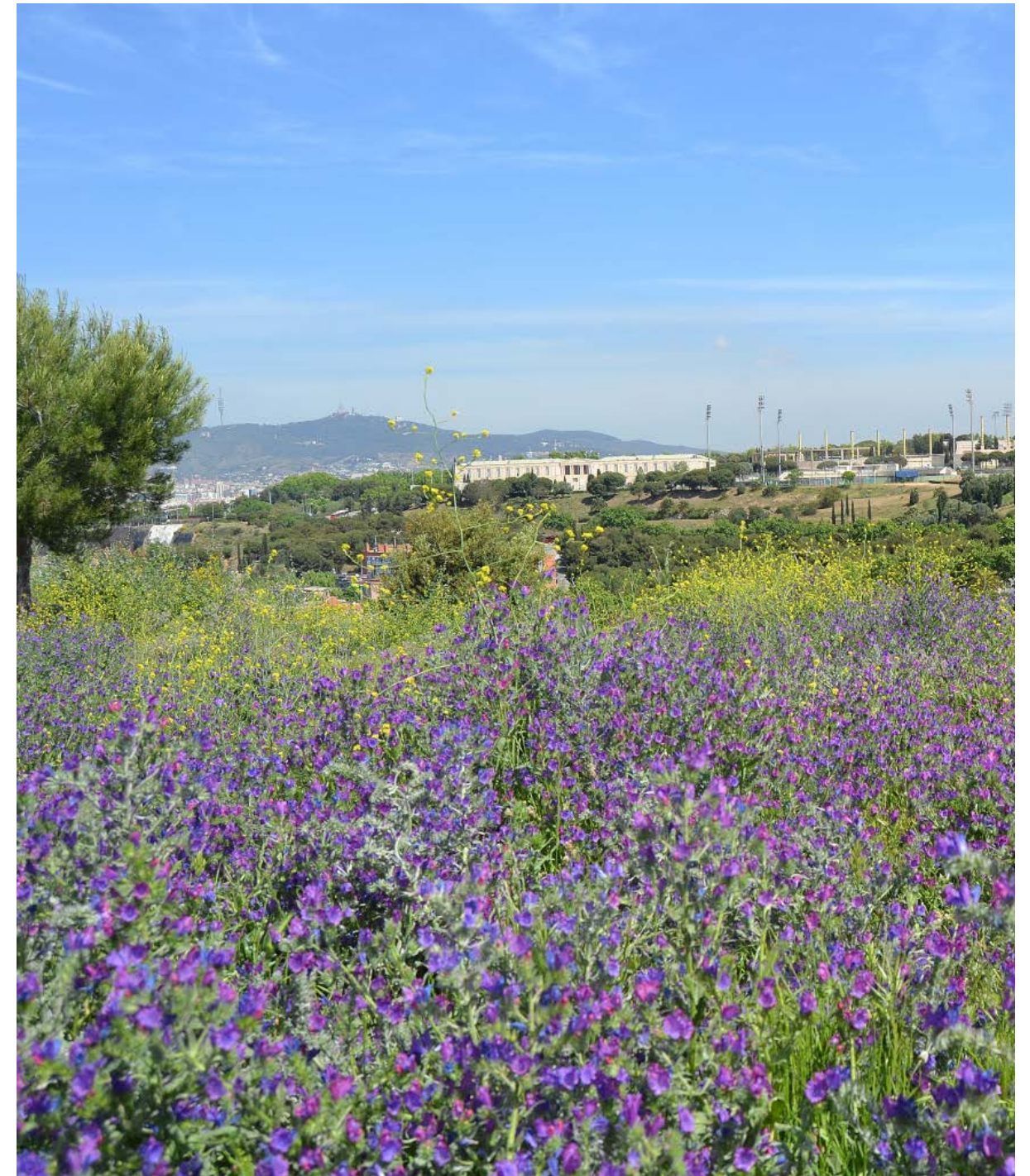
Barcelona is not noted for having large extensions of grass, though some historical parks (Ciutadella, Montjuïc, Palau de Pedralbes) do have a notable presence of grass. Over the last few decades, with the creation of new parks and gardens throughout the city’s districts, there has been an increase in the surface area allocated to grass. The Estació del Nord and Parc de la Trinitat are examples of parks with generous spaces of grass. As for grasslands, these can be found in peri-urban spaces and on plots of land inside the city centre waiting to be put to new use (building or gardening). Grass provides space that is appreciated by city residents whether for playing games, holding gatherings or celebrations or for resting in.

A more sustainable management

A more sustainable urban management implies changes involving rationalised use of resources. As grass maintenance creates considerable demands on water and resources (staff, maintenance, etc.), it would be useful to develop new criteria more in line with sustainability. A definition is therefore needed for a graded series of types of green (lawns, fields and grasslands) according to their maintenance. Current herbaceous species, the locations of these spaces and the uses that city residents put to them will determine the maintenance associated with each type of green. This will mean making regular maintenance in the city’s parks and gardens compatible with naturalisation in selected sites and involve leaving lawns to develop. Such maintenance will require reduced intervention when it comes to mowing, irrigating and clearing, thereby creating a new model of treatment - without lowering the aesthetic and functional quality of these places - that is also intended to ensure a more sustainable management of resources and an increase in biodiversity.

Naturalising leads to an increased number of herbaceous species to the benefit of fauna. Such initiatives are being tried out in parks with large extensions of grass, such as Parc de la Trinitat. Work is currently going ahead to enable such practices to be exported to other parks, with the idea of adapting them to specific biodiversity and resource-saving needs.

Changes in paradigm have to be made through an ongoing dialogue where explanations can be given to city residents on the goals behind each initiative. Naturalisation practices are sometimes confused with carelessness or lack of maintenance, leading to rejection or scepticism at the least. That is why new criteria have to be linked to the goal of improving urban green space and biodiversity and, by extension, quality of life and a commitment to sustainability.



Viper's bugloss (*Echium vulgare*) grassland on Montjuïc.

Conserving grasslands on unused land to preserve biodiversity



Unused land
in Carrer de la
Mare de Déu
del Coll

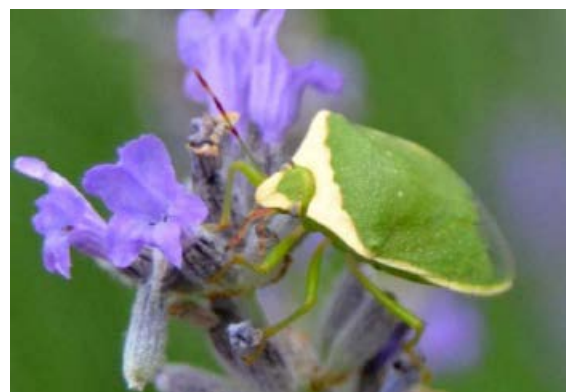
Description/application

Grasslands are found not just in peri-urban areas but also in the city, where they establish themselves on unused land. Such grasslands are made up of a whole series of herbaceous annual plants, such as false yellowheads, thistles, fennel, brèdes and grasses, all adapted to living in altered environments and natural colonisers of these open spaces.

These grasslands play a vitally important ecological role:



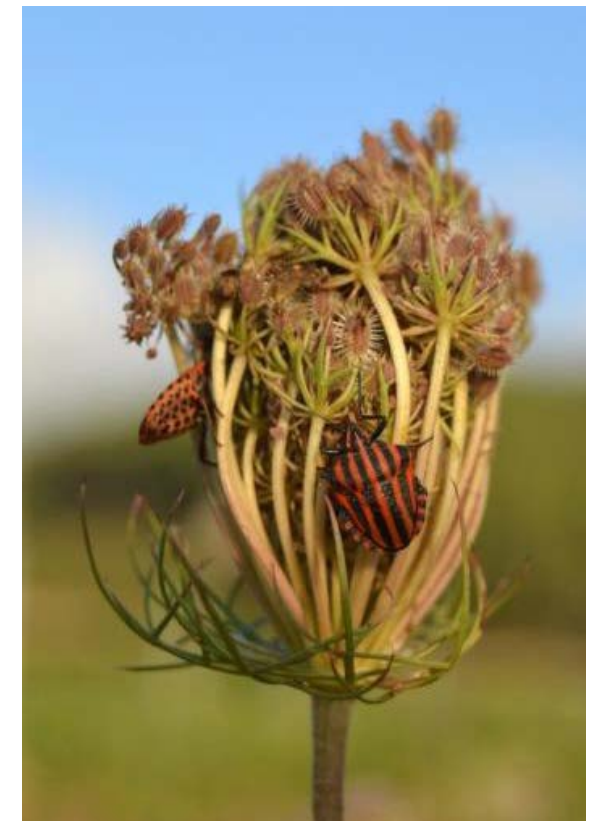
Uromenus rugosicollis



Southern green shield bug (*Nezara viridula*)

→ A large number of invertebrates are establishing themselves there, so enriching the area's biodiversity while also providing a food resource for amphibians, reptiles, insectivorous birds and some mammals. Grasslands also offer protection to the larvae and eggs of many invertebrates spending the winter sheltered in these spaces. Once again, all this biodiversity will benefit the landscape's natural balance and quality.

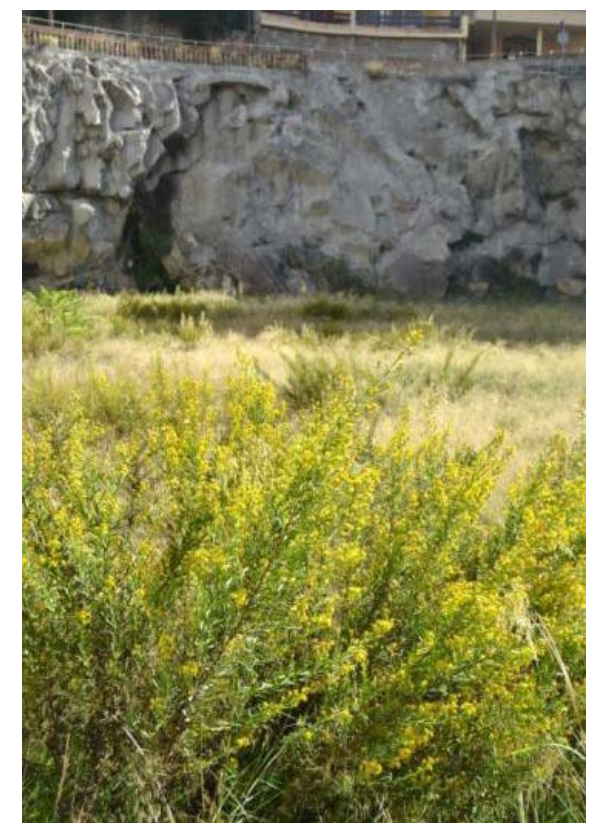
→ These spaces produce large quantities of seeds during the winter which will be used as food for goldfinches (*Carduelis carduelis*), greenfinches (*Carduelis chloris*), serins (*Serinus serinus*) and house sparrows (*Passer domesticus*), among other species, during a time of the year when food resources are scarce. Grasslands are also important in the spring, given that the above-mentioned granivorous species of birds will feed their offspring with small insects during the breeding season. (See **annexe 1: Ruderal vegetation of use to fauna.**)



Italian striped-bug (*Graphosoma lineatum*) on
a wild carrot (*Daucus carota*)



Fruiting false yellowhead (*Dittrichia viscosa*)



Flowering false yellowhead (*Dittrichia viscosa*)

→ The spring flowering of these grasslands helps to attract a large quantity of pollinating insects. (See *annexe 2: Bees and solitary wasps* and see *annexe 3: Beekeeping flora*).



Large white butterfly (*Pieris brassicae*) sipping from a Bermuda buttercup (*Oxalis pes-caprae*)



White rocket (*Diplotaxis eruroides*)



Cleopatra butterfly (*Gonepteryx cleopatra*) sipping from viper's bugloss (*Echium vulgare*)



Common poppies (*Papaver rhoeas*) and sage (*Salvia officinalis*)

→ These make up the habitat of very beneficial fauna that play a part in the biological control of pests and diseases in parks and gardens. Such is the case with hoverflies (wasp-shaped flies). They are identifiable by their stationary fly-ing. Their larvae feed on aphids.

Such species therefore need to be conserved, so it is important to prevent the accumulation of rubbish (often associated with the presence of rats) which gives it a degraded, marginal appearance that fails to do justice to its ecological importance. Conservation work on grasslands can be accompanied with appropriate signage to promote the natural value of these herbaceous communities.



Hoverfly family

Conserving barren vegetation *to preserve biodiversity*



Barren vegetation along Carrer de la Farigola

Description/application

Barren vegetation, defined as large spaces with little herbaceous cover, are becoming sites of great natural value, seeing as they provide a habitat for many species of birds that feed off the ground. Such is the case of wood pigeons (*Columba palumbus*), whose diet not only consists of tree leaves but also a large variety of seeds and fruit they find on the ground. Black redstarts (*Phoenicurus ochruros*), white wagtails (*Motacilla alba*) and, above all, in the winter, species of birds from the finch family such as common chaffinches (*Fringilla coelebs*) use such barren land, with little herbaceous cover, for feeding on seeds.

It is advisable to conserve barren land and prevent it from being used as a space for rubble and rubbish dumps given its important natural value. Signage can be worked on to inform city residents of the importance of these spaces.



Black redstart (*Phoenicurus ochruros*)



White wagtail (*Motacilla alba*). Photo: Xavier Ferrer

The area running from the border of the field to the shrubs has to be mowed *to preserve its fauna*

Description/application

When a field or grassland has to be mowed or cleared, it will be done in such a way that the fauna there are provided with the means for escaping to shelter areas, such as groups of shrubs, flower beds or rocks. This means starting the mowing from the area with the most visitors and directing the mowing or clearing towards shelter areas. Such initiatives can be considered where clearings have to be made to allow for fire-protection buffer strips.



Jardins de Joan Brossa

In the specific case seen in the photo below, it is preferable to start clearing from the bottom to the top and not to create islands of grass that are difficult for fauna to escape from.



Jardí de Petra Kelly. Montjuïc



Parc de la Trinitat

Defining types of lawns, fields and grasslands associated with a specific form of maintenance to boost biodiversity



Parc de la Trinitat

Description/application

→ A programme has to be established for defining several types of lawn so that each one is associated with a specific level of maintenance. Parameters such as mowing frequency and height will enable us to have everything from lawns that are conventionally maintained (located in iconic or historical places or needed as leisure spaces by public demand) to fields and grasslands that have fewer maintenance requirements.

→ Barcelona currently has several types of lawn. Temperate-climate lawns (C3) and hot-climate lawns (C4) on the one hand, and fields on the other. The aim behind this document is to take an in-depth look at the concept of fields and establish several categories of them, based on management criteria, mainly mowing frequency and height and irrigation.



Carrer de Montevideo. Grassland



Field on Plaça de les Glòries Catalanes

So then, the following types are proposed for the purposes of this document:

Temperate-climate lawns (C3): present considerable maintenance costs and high requirements for water resources. They are made up of mixtures of seeds from three or four rural grass species that offer vigour throughout the year and resistance to trampling, dryness and occasional puddles. Combinations of *Festuca arundinacea*, *Lolium perenne* and *Poa pratensis* are common in public parks, with *Cynodon dactylon* added to areas with milder temperatures and *Festuca rubra* to lawns with greater shade. Their optimal development is at temperatures between 12°C and 24°C. They need intense maintenance that varies according to the species that make up the lawn, the use that the public make of them and their location, among other factors.

Hot-climate lawns (C4): are better at resisting dryness and high temperatures than temperate-climate lawns and are therefore associated with fewer water requirements and less maintenance work. Besides having their optimal development at high temperatures (25°C-35°C), they tolerate mowing completely and require less manure and fertiliser than C3 temperate-climate lawns. During the winter they enter a period of dormancy and turn yellowish. *Zoysia sp.*, *Paspalum sp.* or *Cynodon sp.* are just a few of the species that usually make up hot-climate lawns.

Ornamental and natural fields and grasslands: are established through the development of temperate- or hot-climate lawns and are then managed under a less intense maintenance programme, as defined in the following table:

	Recommended mowing height (mm)	Frequency of mowing	Frequency of watering
Ornamental fields	80 (after flowering)	6-7/ year	1 weekly watering/spring-autumn 2 weekly watering/summer
Natural fields	120	1-3/ year	1 weekly watering/summer
Grasslands	120	1 biennial	No

Guidance maintenance parameters taken from the Technical Gardening Regulations NTJ 14 G Maintaining Non-Sport Lawns and Fields

Special case of wild boars (*Sus scrofa*)

→ The last few years have seen wild boars making more and more frequent inroads into urban areas. This has affected many green spaces, in particular grass parterres with automated irrigation, whose grass carpets wild boars find suitably humid to raise and rummage in search of roots, bulbs and invertebrates such as earthworms.

Night-stalking and battues to control the population of wild boars in Parc de Collserola (currently estimated at around 1000) and capturing problematic wild boars in urban areas are becoming crucial to resolving the problem. As for the latter point, note that wild boars can travel large distances in just a few days (dozens of kilometres) and that once they are used to feeding on the large range of food on offer in the city (cat food, bins, rubbish containers etc.), it is hard for them to change their behaviour. This means they continually return and make incursions into urban areas despite relocating back to the natural environment; among other reasons, because they learn from their mother, while they are still very young, to feed that way and consequently pose a risk to city residents. Even so, the problem of wild boars is becoming so complicated that the initiatives described above have to be accompanied by others that will make it hard for wild boars to enter the city:



Wild boar (*Sus scrofa*) and wild boar piglets. Photo: Sergi Garcia



Effects of wild-boar rummaging in the Parc del Laberint's domestic garden.



Effects of wild-boar rummaging in Creu de Pedralbes

There has to be a reduction in food availability

- No cat-feeding points must be allowed in areas near to Parc de Collserola
- Feeding boxes have to be redesigned to stop wild boars from accessing cat food.
- Launching awareness-raising campaigns to call on residents not to feed wild boars.
- Rubbish containers need to be strengthened with anti-tipping systems.
- Secure and closed design of bins in the peri-urban area to prevent tipping and access to the food leftovers they may contain.

Access to the city must be made more difficult for wild boars

- Clearing shrubby covers in areas of conflict, either by mechanical means or putting sheep or goats out to pasture there.
- Strengthening perimeter fences, if possible with a concrete base, to prevent wild boars from accessing the parks affected.
- Using electric fences to strengthen perimeter fences.
- Installing cattle grids.

Change in type of vegetation

- Change in the management of the grass parterres near the Barcelona-facing slope in Parc de Collserola. The proposal is for these spaces to be gradually replaced by dry fields, which are no doubt less attractive to this mammal. (See annexe 4: Mediterranean dry grasslands).



Cat-feeding points have to be kept further away and work done on their design



Bins with lids to prevent wild boars from accessing food leftovers

Understoreys have to be removed in areas of conflict



Fence around the Parc del Laberint d'Horta's domestic garden



Parc del Laberint d'Horta's perimeter fence



Cattle grid, Parc de les Hores



Adapting the maintenance of lawns *to boost biodiversity*



The Palau de Pedralbes Gardens

Description/application

Lawns are seen as leisure spaces and therefore subject to strong citizen pressure and require a considerable effort to maintain them. Such intense maintenance makes lawns of little use to fauna, although it should be pointed out that generalist species of birds such as wood pigeons (*Columba palumbus*), black-birds (*Turdus merula*) and white wagtails (*Motacilla alba*) usually search for food on lawns.

→ Despite the dry periods both temperate- and hot-climate laws are subject to, where the associated maintenance levels so permit and useful flowering plant species are observed, a delay in the first mowing, to respect such flowering and allow insects access to nectar and pollen as soon as possible, constitutes a good management measure to the benefit of biodiversity.



Wood pigeon (*Columba palumbus*).



Jardins de Mossèn Cinto Verdaguer

Selecting spaces capable of conversion to fields or grasslands *to increase their natural usefulness*



Montjuïc grassland

Description/application

→ Suitable spaces have to be selected for such differential treatment, for conversion into fields or grasslands. So, by following general criteria for location, area, public use of the space, sunshine exposure, proximity to water points, maintenance and fire risks, spaces will be selected where naturalisation programmes can be carried out, whether in urban parks, large and small gardens, slopes, natural spaces or even roads and traffic junctions.



Natural field along Carrer dels Jocs del 92



Natural field in Parc de Diagonal Mar

Naturalising lawns and banks to promote biodiversity



Jardins de Joan Brossa

Description/application

→ Lawns and banks that are of little interest to fauna must be left to develop into fields or grasslands and become a habitat that favours biodiversity. There is no need for keeping the herbaceous species homogeneous. Where the space is left to develop into a field or grassland, it will be colonised by several herbaceous species over time, each of which will flower and have associated fauna and therefore continue increasing the ecological value of the space. These spaces become essential in the spring and summer, when they host a community of invertebrates of crucial importance for several groups of fauna, and at the start of winter, with the seeding of herbaceous species that feed numerous granivorous birds.



Feixes de Collserola's grassland

→ **Less mowing:** once the spaces have been selected, the management work must focus on mowing. The type of maintenance that each space receives will depend on the decision to turn it into an ornamental field, a natural field or a grassland.

Ornamental fields: maintenance will involve between six and seven mowings a year. Note that the location of the field, the herbaceous species of which it is formed, the resources available and other factors such as rain and humidity will end up determining the mowing calendar. As a guideline:

Ja-nuary	Fe-bruary	March	April	May	June	July	August	Septem-ber	October	November	December
	●	●		●		●		●		●	

Mowing clippings need to be incorporated into the surface of the fields, except where they may pose a fire risk.

Natural fields: maintenance will involve between one and three mowings a year. This less intensive mowing will need to respect spring flowering and autumn seeding (October), whereby a correct maintenance programme will have to consist of a single mowing at the start of March and no subsequent mowing until the autumn-winter. Many natural fields require mowing during the April-May period. Note that these spring mowings provide fields with flowers during the summer. As a guideline:

Ja-nuary	Fe-bruary	March	April	May	June	July	August	Septem-ber	October	November	December
		●		▲					●		

▲ = optional

Mowing clippings need to be incorporated into the surface of the fields, except where they may pose a fire risk.

Grasslands: maintenance involves a biennial mowing to maintain the field's herbaceous state. Tall-grass and wild-flower areas will create a feeding and breeding habitat for butterflies and other invertebrates, so constituting the bottom of the food chain that other groups of fauna will feed from.



→ **Increased mowing heights:** high mowing heights allow the flowering to be respected of species such as white clover (*Trifolium repens*) and common daisies (*Bellis perennis*), both low-growing plants and very useful for their flowers, which are rich in nectar and pollen. High mowing heights also enable fields to retain a certain degree of humidity, thereby benefiting invertebrate while reducing the frequency of watering.

	Recommended mowing heights (mm)
Ornamental fields	80
Natural fields	120
Grasslands	120



Dark clouded yellow (*Colias crocea*) sipping from a clover (*Trifolium* sp.)



Common daisies (*Bellis perennis*)

→ **Reduced frequency of watering:** fields and grasslands in general must not have too much water an the management should focus on mowing. This will therefore enable us to save on water consumption.

Ornamental fields: these will be watered according to their needs and the time of year. The appropriate amounts of watering determined will be supplied. As a guideline: a weekly watering in the spring and autumn and two waterings a week in the summer. Spaces close to sprinklers and other irrigation elements must be cleared from time to time so water can be sprayed without any obstacle in the way.

Natural fields: these will be watered once a week during the summer period.

Grasslands: these will not be watered.



Parc de la Trinitat

Applying differentiated mowing to improve the landscape and biodiversity, according to use



Grassland on Sot del Migdia. Montjuïc

Description/application

The uniformity of the space has to be broken up by providing it with several herbaceous layers, based on aesthetic and functional criteria.

→ Mowed or cleared pathways need to be created inside fields or grasslands for people to walk along and prevent trampling on naturalised areas while encouraging the public to observe the biodiversity associated with these spaces. Depending on their width, such areas can also act as fire-protection buffer strips.

→ Creating herbaceous layers at several heights depending on how close they are to more visited areas and thereby establishing a lesser to greater height gradient the further we get from transit areas (paths, roads, facilities etc.) For example, beside a path or highly visited area, the first two or three metres can be cut at 10 cm. From then on, the further away we are from the transit area, new herbaceous buffer strips can be created by steadily increasing their heights.



Parc de la Trinitat



Jardins de Joan Brossa

→ Geometric elements or winding strips of vegetation will have to be incorporated for landscape purposes.

→ Geometric figures will have to be created around tree trunks to prevent weeding-machines blades from cutting into tree bark and reduce maintenance work.

→ Such differentiated mowing can involve a redistribution of certain areas' public uses. For example, people will not be able to picnic or read on areas where the grass is higher. It is advisable to use signage for directing the public on how they should use these spaces.



Yoga enthusiasts. Parc de la Ciutadella.



Parc de la Trinitat



Meadow on Turó Park used as an area for dogs



Parc de la Trinitat



Picnic. Passeig de Sant Joan

Planting groups of shrubs or fruit trees on lawns and fields *to promote biodiversity*



Jardins de William Shakespeare

Description/application

→ Lawns and fields need to be made more structurally complex through the presence of shrub borders (mastic trees, chaste trees, rose bushes, bramble bushes, etc.), or fruit-bearing trees such as cherry trees, plum trees, apple trees which can be used as feeding, sheltering and breeding places for wild fauna.



Olive trees (*Olea europaea*). Parc de la Trinitat

Planting flower beds with alternative species to grass *to promote biodiversity*



Ivy (*Hedera helix*) parterres. Parc del Laberint d'Horta

Description/application

→ Creepers requiring less expenditure on water may be considered as an alternative to grass. Creepers generally tolerate moderate trampling, are aesthetically pleasing and, in some cases, present flowers that are attractive to bees and other pollinating animals. Very attractive combinations can be made. Example: *Lippia nodiflora* and *Achillea crithmifolia*. The former produces a summer carpet of small green leaves and abundant and very melliferous white and pink flowers, while the latter develops vigorously during the winter.

Another option, already present in the city, is to plant ivy in parterres, and yet another, to plant species such as bigleaf periwinkle (*Vinca major*) and asparagus fern (*Asparagus densiflorus*).



Carrer de Mandri at its junction with Ronda del General Mitre

Sowing grasslands to promote biodiversity



Roof of the Biblioteca Zona Nord, in Nou Barris

Description/application

→ When we consider creating grasslands by direct sowing, we will need to take care in choosing plants that are useful for the fauna. Some species of birds show a preference for certain grasses. So, for example, finches and sparrows like false yellowheads, brèdes, thistles and Brassicaceae in general, such as white rocket.

→ It would be useful to sow alfalfa fields where the public are expected to use it for various one-off activities, given that the plant offers a useful nectar-secreting content for pollinating fauna, on the one hand, and, on the other, thanks to its large capacity to re-shoot, tolerates two and even three annual clearings, making it easier to maintain these spaces.



Grassland made up of fennel, common thatching grass and other grasses. Parc de Montjuïc



Alfalfa (*Medicago sativa*) fields. Plaça de les Glòries

→ If butterflies are wanted in these grasslands then:

- Suitable host plants will have to be grown for each species of butterfly. So, for example, red admirals (*Vanessa atalanta*) use eastern pellitory-of-the-wall (*Parietaria officinalis*) and stinging nettle (*Urtica sp.*) as host plants while the common blue (*Polyommatus icarus*) uses alfalfa (*Medicago sativa*) and common bird's-foot trefoil (*Lotus corniculatus*) among other plants.

Note that many species of butterflies present a considerable degree of specificity as they use a specific species or species from the same botanical family as host plants.

It is advisable to plant native species and complement host plants with flora that are rich in nectar, such as knapweed, pincushion flowers and viper's bugloss.

- Sowing plants with nectar-secreting flowers for adults to feed on. Many flowers in the city that are used for attracting adults are alien species, which offer nectar with features similar to that of native plants. So, while the butterflies are clearly dependent on laying eggs on native plants, when it comes to adult feeding, there are no significant generic differences in nectar-secreting content between the native and alien species.



Cleopatra butterfly (*Gonepteryx cleopatra*)



Common blue (*Polyommatus icarus*)



Viper's bugloss (*Echium vulgare*)



knapweed (*Centaurea sp.*)

Complementary initiatives on lawns and fields to promote biodiversity



Wooden pyramid at Mas Ravetllat

Description/application

- Installing insect hotels and spirals to promote pollinating fauna.
- Installing wooden pyramids to promote wood-eating insects.
- Given the scarcity of mud in urban contexts, certain lawn and field areas could be used for creating bogs for swallows and enabling them to gather material for building their nests. Whether or not there are nearby water points will determine the feasibility of such initiatives.



Bosc de Turull insect spiral

Promoting new criteria to gain public involvement and support for new initiatives



Description/application

- A good idea is to use informative material to link naturalised grass areas and differentiated treatment to increased biodiversity and rationalised urban management. And link these aspects to improved quality of life.

RUDERAL VEGETATION OF USE TO FAUNA

Ruderal vegetation is made up of a series of herbaceous species that opportun-
istically appear in soils which have been damaged as a result of land movements,
fires, abandoned land etc. In ecological terms, these herbaceous species pres-
ent an opportunistic reproductive strategy known as “r-strategy”. Thanks to their
high production of seeds during their annual cycle, these plants have a high re-
productive potential which enables them to be the first to colonise spaces that
have undergone some sort of alteration. They are therefore species typical of the
first stages of colonisation.

Specialist or K-strategy individuals, however, have less reproductive potential
but reproduce during their long biological cycle. These are more complex species
that are better at competing for resources and which consequently end up sup-
planting the opportunistic species in stable environments.

In any case, this type of ruderal vegetation is of vital importance for fauna, seeing
as many insects and birds too feed on them directly. So, for example, adult paint-
ed ladies (*Vanessa cardui*) not only feed on the nectar of thistle flowers but also
use nettle, mallow and viper’s bugloss, among other species, as their host plant.
European serins (*Serinus serinus*) and European greenfinches (*Carduelis chlo-
ris*) show a great predilection for the seeds of white rocket (*Diplotaxis eruroides*)
and watercress-leaved rocket (*Erucastrum nasturtiifolium*) while European gold-
finches (*Carduelis carduelis*) have a beak that is specially adapted for gathering
thistle seeds. These are just a few of the many examples that demonstrate how
ruderal plants play a crucial role in biodiversity.



Painted lady (*Vanessa cardui*) on bougainvillea

A few examples of ruderal plants of use for feeding pollinating insects:

Scientific name	Common name
<i>Alyssum maritimum</i>	Sweet alyssum
<i>Artemisia vulgaris</i>	Mugwort
<i>Borago officinalis</i>	Borage
<i>Brachypodium phoenicoides</i>	Thinleaf false brome
<i>Calendula arvensis</i>	Field marigold
<i>Centaurea sp.</i>	Centaury
<i>Centaurea aspera</i>	Rough star-thistle
<i>Centaurea paniculata</i>	Jersey knapweed
<i>Cirsium vulgare</i>	Spear thistle
<i>Convolvulus arvensis</i>	Field bindweed
<i>Daucus carota</i>	Wild carrot
<i>Diplotaxis eruroides</i>	White rocket
<i>Echium vulgare</i>	Viper’s bugloss
<i>Epilobium hirsutum</i>	Great willowherb
<i>Eryngium campestre</i>	Field eryngo
<i>Foeniculum vulgare</i>	Fennel
<i>Galactites tomentosa</i>	Purple milk thistle
<i>Galium aparine</i>	Cleavers
<i>Galium lucidum</i>	Goose grass
<i>Lotus corniculatus</i>	Common bird’s-foot trefoil
<i>Malva sylvestris</i>	Common mallow
<i>Melilotus sp.</i>	Melilot
<i>Mercurialis annua</i>	Annual mercury
<i>Psoralea bituminosa</i>	Pitch trefoil
<i>Reichardia picroides</i>	Brighteyes
<i>Scabiosa atropurpurea</i>	Mourningbride
<i>Senecio vulgaris</i>	Groundsel
<i>Sinapsis alba</i>	White mustard
<i>Silybum marianum</i>	Milk thistle
<i>Sonchus oleraceus</i>	Common sowthistle
<i>Sonchus tenerimus</i>	Slender sowthistle
<i>Taraxacum officinale</i>	Common dandelion
<i>Urospermum dalechampii</i>	Smooth Golden Fleece
<i>Urtica dioica</i>	Common nettle

A few examples of ruderal plants of use to granivorous birds:

Common name	Scientific name	Bird
Lamb's quarters	<i>Chenopodium album</i> , <i>Chenopodium murale</i> , <i>Amaranthus retroflexus</i> , <i>Amaranthus albus</i> , etc.	European serins and Southern green shield bugs
Thistles	<i>Sylibum</i> sp., <i>Centaurea</i> sp., <i>Cardus</i> sp., <i>Cirsium</i> sp., <i>Onopordum</i> sp.	European goldfinch
White rocket	<i>Diplotaxis erucoides</i>	European serins and Southern green shield bugs
Watercress-leaved rocket	<i>Erucastrum nasturtiifolium</i>	European serins and Southern green shield bugs
False yellowhead	<i>Dittrichia viscosa</i>	European goldfinch



Common nettle (*Urtica dioica*)



Pitch trefoil (*Psoralea bituminosa*)



Wild carrot (*Daucus carota*) with longhorn beetles (*Chlorophorus varius*), a regular visitor of umbelliferae family plants and composts



Common thatching grass (*Hyparrhenia hirta*)



Fennel (*Foeniculum vulgare*)



Rough star-thistle (*Centaurea aspera*)



Annual mercury (*Mercurialis annua*)



Field marigold (*Calendula arvensis*)



Common mallow (*Malva sylvestris*)



Red-root amaranth (*Amaranthus retroflexus*)



Sweet alyssum (*Alyssum maritimum*)



Purple milk thistle (*Galactites tomentosa*)



Borage (*Borago officinalis*)



Field bindweed (*Convolvulus arvensis*)



Sowthistle (*Sonchus* sp.)



Watercress-leaved rocket (*Erucastrum nasturtiifolium*)



Field eryngo (*Eryngium campestre*)

BEES AND SOLITARY WASPS

Pollinating insect populations are dropping in number worldwide, with serious repercussions on the functioning of our ecosystems. In fact, it is estimated that 80% of wild flowers and 70% of cultivated plants depend directly on the pollinating activities of such insects, mainly bees and wasps, but also cockroaches, butterflies and other species.

When we refer to bees, the truth is we immediately think of western honey bees (*Apis mellifera*), the best-known of all bees or perhaps also bumblebees (*Bombus* sp.); in any case, however, they are not the only representatives of the hymenoptera order to pollinate, as there are many other known species of hymenoptera described as bees and solitary wasps. While these species do not live in colony-forming hives or with the social organisation of honey bees and bumble bees, it should be noted that they play an equally important role in pollinating flowers.



Western honey (*Apis mellifera*) on a Chinese wisteria (*Wisteria sinensis*)

Many of these species of bees and solitary wasps have been declining in numbers due to the use of agricultural pesticides, loss of quality herbaceous habitats and fragmentation of habitats. It has only been the over last few years that they started to receive recognition for their ecological value.

There are some thousand species of bees and over 700 species of solitary wasps in Spain. Each of these species has its own specific features and therefore feeds from different flowers and uses specific nesting substrates. So, most of these species nest directly on the ground, whether on bare soil or with a certain amount of herbaceous cover, depending on the species, although there are also other species that use dry materials, such as herbaceous plant stems or trunks, for nesting in.

Bees and solitary wasps devote a considerable part of their lives to finding a good place for nesting and laying their eggs in. Bees and wasps do not stay on in their respective hives and nests but lay their eggs in them and provide food there so their larvae can develop properly. Females die before the next generation hatch and males, which live solely to reproduce, have an even shorter lifespan. Bees supply their hives with plant-based food (pollen and nectar) and, therefore, pollinate many plants in the process, whereas wasps provide their nests with animal-based food (insects and spiders), thereby controlling populations of pest insects while helping to maintain the equilibrium in ecosystems.

Species of bees in our environment include:

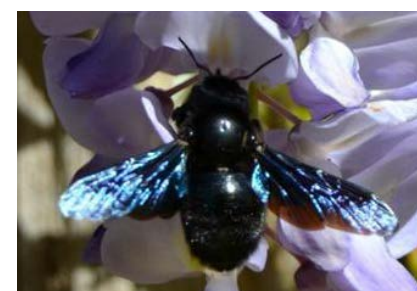
BUFF-TAILED BUMBLEBEE (*Bombus terrestris*)



Habitats: once the winter cold has passed, queen bees search for abandoned underground dens or tree hollows or holes in walls for nesting. Queen bees are not the only females to survive in the winter. The nest here is where they build a ball, made of grass, pollen and nectar, which they then use for laying their eggs in. They also build a container from wax where they keep the nectar and pollen for feeding their larvae off-spring. It is from this first batch of fertilised eggs that the first infertile (female) drones emerge, in search of food to feed the new larvae with. Towards the end of the summer, after their colonies have made considerable development, the queen bees lay unfertilised eggs, which turn into males, as well as fertilised eggs, which become new queen bees. Males are not part of the colony and live solely to fertilise new queen bees. These bumblebees all die during the cold season, except for new queen bees, which, by now fertilised, go out in search of a new den for spending the winter and creating a new colony for when the good weather returns.

Ecology: they pollinate between 25 and 30 flowers a minute and remain active above 5° C. They are therefore great pollinators and very useful in agriculture.

CARPENTER BEES



Violet carpenter bee (*Xylocopa violacea*)

Habitats: they are noted as the only bees that are able to bore hives in soft wooden branches and trunks, thanks to their powerful mandibles. They create long tunnels where they lay their eggs along with a mixture of pollen and nectar for feeding their larvae on. They also re-use hives. An example of carpenter bees are violet carpenter bees (*Xylocopa violacea*), which can be easily identified by the metallic-blue colour of their wings and the characteristic sound of their flying.

LEAFCUTTER BEES



Leafcutter bee (*Megachile* sp.).
Photo: Wikimedia



Detail of cut strawberry tree leaves (*Arbutus unedo*)

Habitats: nesting substrates vary considerably depending on the species, although there is a preference for soft wooden cavities, which these bees fill with pieces of leaves they themselves cut out, while reducing the surface area of leaves. Their leaf-cutting does not generally pose any serious problems for the plant. Dense plant stems and soil are also used as nesting substrates. Curiously enough, unlike honey bees and bumble bees, which transport pollen in “baskets” on their hind legs, leafcutter bees transport pollen on the ventral part of their abdomen using its specialised hairs. Considered one of the most efficient groups in pollinating, this family is made up of numerous species, most of which feed on pollen and nectar. The family’s main genera include: *Osmia*, *Megachile* and *Anthidium*.

CUCKOO BEES



Cuckoo bee (*Halictus* sp.)

Habitats: so called because they enter the nests of pollen- and nectar-collecting species and lay their eggs in their honeycombs. When cuckoo bee larvae hatch from their eggs, they feed on the nest’s stored pollen and on the host species’ larvae. They nest on the ground. Some of the main genera are *Halictus*, *Lasioglossum* and *Sphecodes*.

WASPS



European paper wasp (*Polistes dominula*)



European or German wasp (*Vespa germanica*)

Habitats: the European paper wasp (*Polistes dominula*) and the European or German wasp (*Vespa germanica*) are two of the species found in the city. The two species can be distinguished through their respective morphological features and habits. So, European or German wasps have black antennae, yellow legs and a yellow and black pattern on their abdomen consisting of a black triangle and two black dots across each segment. European paper wasps, however, have orangey antennae and legs and a different abdominal pattern; when they fly, their hind legs can be seen trailing underneath.

Paper wasps create rather small colonies. Their nests are made from a mixture of vegetable fibres and saliva and are joined up by a peduncle to walls, shrubs, roofs and other sheltered places that offer some protection.

They mainly feed on insects and spiders and, to a lesser extent, on nectar and sugary substances they often extract from mature fruit.

European or German wasps build large nests that are normally located on the ground, either entirely or partially buried. They also take advantage of abandoned dens. They feed on insects and spiders, nectar and sugary substances. They behave more aggressively than paper wasps.

Note, however, that there is a large diversity of wasp families in the hymenoptera order, some of which are predators and therefore consumers of insects and spiders while others are endoparasites, such as ichneumonidae, whose females use their long stinger to lay their eggs inside the animals they parasitise (spiders and caterpillars). In sum, they are a very useful group in the fight against pests in our green spaces.



Nest of European paper wasp (*Polistes dominula*)



Nest of European wasp. Photo: Wikimedia

MEASURES FOR BOOSTING BEES AND SOLITARY WASPS:

- Conserving grasslands. In the winter too, so they can be used as shelters for bees and wasps
- Leaving the dry stems of herbaceous plants once they have flowered so they can be used as a breeding substrate
- Conserving areas without herbaceous cover (bare soil)
- Not using phytosanitary products
- Boosting the presence of beneficial fauna
- Planting beekeeping flora in places with good exposure to the sun
- Boosting the use of native plants
- Diversifying plant species and taking account of the range of flowering to cover most of the year
- Avoiding the use of invasive plants as well as double- and multi-petal ornamental plants that often have no nectar or are difficult to access
- Putting up hotels for bees and solitary wasps
- Putting up insect spirals to encourage solitary bees nesting on the ground
- Putting up watering troughs
- Leaving certain areas of parks and gardens at rest, to boost the flowering of their plants and thereby encourage pollinating insects.
- Making mowing less frequent and increasing cutting heights



BEEKEEPING FLORA

TREES

Scientific name	Common name
<i>Acer campestre</i>	Field maple
<i>Acer monspessulanum</i>	Montpellier maple
<i>Acer negundo</i>	Box elder
<i>Acer opalus</i>	Italian maple
<i>Acer platanoides</i>	Norwegian maple
<i>Ceratonia siliqua</i>	Carob tree
<i>Citrus aurantium</i>	Seville orange tree
<i>Citrus limon</i>	Lemon tree
<i>Eucalyptus camaldulensis</i>	Murray red gum
<i>Eucalyptus globulus</i>	Tasmanian blue gum
<i>Olea europaea</i>	Olive tree
<i>Populus alba</i>	White poplar
<i>Populus × canadensis</i>	Grey poplar
<i>Populus nigra</i>	Black poplar
<i>Populus tremula</i>	Aspen
<i>Prunus armeniaca</i>	Armenian plum tree
<i>Prunus avium</i>	Wild cherry tree
<i>Prunus cerasifera</i>	Purple-leaf cherry plum tree
<i>Prunus domestica</i>	Plum tree
<i>Prunus dulcis</i>	Almond tree
<i>Prunus mahaleb</i>	Mahaleb cherry
<i>Prunus persica</i>	Peach tree
<i>Pyrus communis</i>	Common pear tree
<i>Pyrus malus</i>	Apple tree
<i>Quercus cerrioides</i>	Turkey oak
<i>Quercus faginea</i>	Scarlet oak
<i>Quercus ilex</i>	Holm oak
<i>Quercus pubescens</i>	Downy oak
<i>Quercus robur</i>	English oak
<i>Quercus suber</i>	Cork oak
<i>Robinia pseudoacacia</i>	White acacia
<i>Salix alba</i>	White willow
<i>Salix atrocinerea</i>	Grey willow
<i>Salix babylonica</i>	Chinese weeping willow
<i>Salix elaeagnos</i>	Hoary willow
<i>Tilia cordata</i>	Small leaved lime
<i>Tilia platyphyllos</i>	Large-leaved lime

Source: www.floracatalana.net/llistes/flora-apicola

SHRUBS AND CLIMBING PLANTS

Scientific name	Common name
<i>Anthyllis cytisoides</i>	N/A
<i>Arbutus unedo</i>	Strawberry tree
<i>Asparagus officinalis</i>	Wild asparagus
<i>Bupleurum fruticosum</i>	Shrubby hare's ear
<i>Buxus sempervirens</i>	Boxwood
<i>Calluna vulgaris</i>	Common heather
<i>Cistus albidus</i>	Grey-leaved cistus
<i>Cistus clusii</i>	Cistus clusii
<i>Cistus crispus</i>	Curled-leaved rock rose
<i>Cistus ladanifer</i>	Gum rockrose
<i>Cistus monspeliensis</i>	Montpellier cistus
<i>Cistus salviifolius</i>	Sage-leaved rock-rose
<i>Crataegus monogyna</i>	Common hawthorn
<i>Dorycnium pentaphyllum</i>	Prostrate Canary clover
<i>Erica arborea</i>	Tree heath
<i>Erica multiflora</i>	Heather
<i>Hedera helix</i>	Common ivy
<i>Hyssopus officinalis</i>	Hyssop
<i>Ilex aquifolium</i>	Common holly
<i>Laurus nobilis</i>	Sweet bay
<i>Lavandula angustifolia</i>	Lavender
<i>Lavandula latifolia</i>	Broadleaved lavender
<i>Lavandula stoechas</i>	Spanish lavender
<i>Marrubium vulgare</i>	Japanese mock orange
<i>Prunus spinosa</i>	Blackthorn
<i>Quercus coccifera</i>	Scarlet oak
<i>Rhamnus alaternus</i>	False olive
<i>Rosa canina</i>	Dog-rose
<i>Rosa rubiginosa</i>	Evergreen rose
<i>Rosa sempervirens</i>	Evergreen rose
<i>Rosmarinus officinalis</i>	Rosemary
<i>Rubus ulmifolius</i>	Elmleaf blackberry
<i>Salvia microphylla</i>	Baby sage
<i>Salvia officinalis</i>	Sage
<i>Sarothamnus scoparius</i>	Scotch broom
<i>Satureja montana</i>	Winter savory

Scientific name	Common name
<i>Spartium junceum</i>	Spanish broom
<i>Thymus serpyllum</i>	Wild thyme
<i>Thymus vulgaris</i>	Common thyme
<i>Ulex parviflorus</i>	Gorse
<i>Vitex agnus-castus</i>	Chaste tree

Source: www.floracatalana.net/llistes/flora-apicola



Mediterranean buckthorn
(*Rhamnus alaternus*)

HERBACEOUS PLANTS

Scientific name	Common name
<i>Asphodelus fistulosus</i>	Hollow-stemmed asphodel
<i>Borago officinalis</i>	Borage
<i>Centranthus ruber</i>	Kiss-me-quick
<i>Chichorium intybus</i>	Common chicory
<i>Daucus carota</i>	Wild carrot
<i>Dittrichia viscosa</i>	False yellowhead
<i>Diplotaxis eruroides</i>	White rocket
<i>Echium vulgare</i>	Viper's bugloss
<i>Erucastrum nasturtiifolium</i>	Watercress-leaved rocket
<i>Galactites tomentosa</i>	Purple milk thistle
<i>Hyssopus officinalis</i>	Hyssop
<i>Medicago sativa</i>	Alfalfa
<i>Melilotus albus</i>	Bokhara clover
<i>Melissa officinalis</i>	Lemon balm
<i>Mentha suaveolens</i>	Apple mint
<i>Mentha pulegium</i>	European pennyroyal
<i>Ocimum basilicum</i>	Basil
<i>Origanum vulgare</i>	Orenga
<i>Origanum majorana</i>	Marjoram
<i>Papaver rhoeas</i> (pollen)	Field poppy
<i>Tanacetum vulgare</i>	Tansy
<i>Taraxacum officinale</i>	Common dandelion
<i>Trifolium arvense</i>	Hare's-foot clover
<i>Trifolium pratense</i>	Red clover

Source: www.floracatalana.net/llistes/flora-apicola



Kiss-me -quick
(*Centranthus ruber*)

MEDITERRANEAN DRY GRASSLANDS

Dry grasslands are plant communities of great biological and landscape interest, many of which, as seen in peri-urban areas, can appear as impoverished and deteriorated spaces. But the fact is, these open spaces often have a landscape heterogeneity that include other plant formations, such as the remains of old agricultural crops, bramble patches, stone pine (*Pinus pinea*) groves and urbanised centres, and therefore offer a mosaic of plants that are extremely useful for biodiversity.



Dry fields of common thatching grass (*Hyparrhenia hirta*). Tres Turons



Dry fields of common thatching grass on Montjuïc cliff. Photo: Teresa Franquesa



Mediterranean dry grasslands along the borders of Carretera de les Aigües. Collserola

Exposure to the sun is a factor that determines the presence of Mediterranean dry grasslands and which gives rise to high-temperature conditions and a strong summer dryness that favours grasses perfectly adapted to this climate. The most representative of these communities are thatching grass (*Hyparrhenia hirta*) and Mediterranean false-brome (***Brachypodium retusum***). They constitute respectively the dry fields of common thatching grass and Mediterranean false-brome thickets, plant communities associated with the African savannah and which find their northern distribution limits in Catalonia.

They make up two herbaceous layers: a higher one dominated by common thatching grass and a second, lower one, dominated by Mediterranean false-brome occupying the remaining spaces free of common thatching grass. The two communities are notable for their yellowish summer colouring, which needs to be reclaimed as part of our Mediterranean landscape. You can find other species associated with these communities, whose notable representatives include:

- Fennel (*Foeniculum vulgare*)
- Fringed rue (*Ruta chalepensis*)
- Spanish broom (*Spartium junceum*)
- Sage-leaved rock-rose (*Cistus salviifolius*)
- Flax-leaved daphne (*Daphne gnidium*)
- Yellow rest-harrow (*Ononis natrix*)
- Mediterranean stonecrop (*Sedum sediforme*)
- Mediterranean phagnalon (*Phagnalon saxatile*)
- Purple milk thistle (*Galactites tomentosa*)
- Three-tooth-leaved Globularia (*Globularia alypum*)
- Mallow bindweed (*Convolvulus althaeoides*)



Mediterranean false-brome (*Brachypodium retusum*)



Common thatching grass (*Hyparrhenia hirta*)



Three-tooth-leaved Globularia (*Globularia alypum*)



Yellow rest-harrow (*Ononis natrix*)



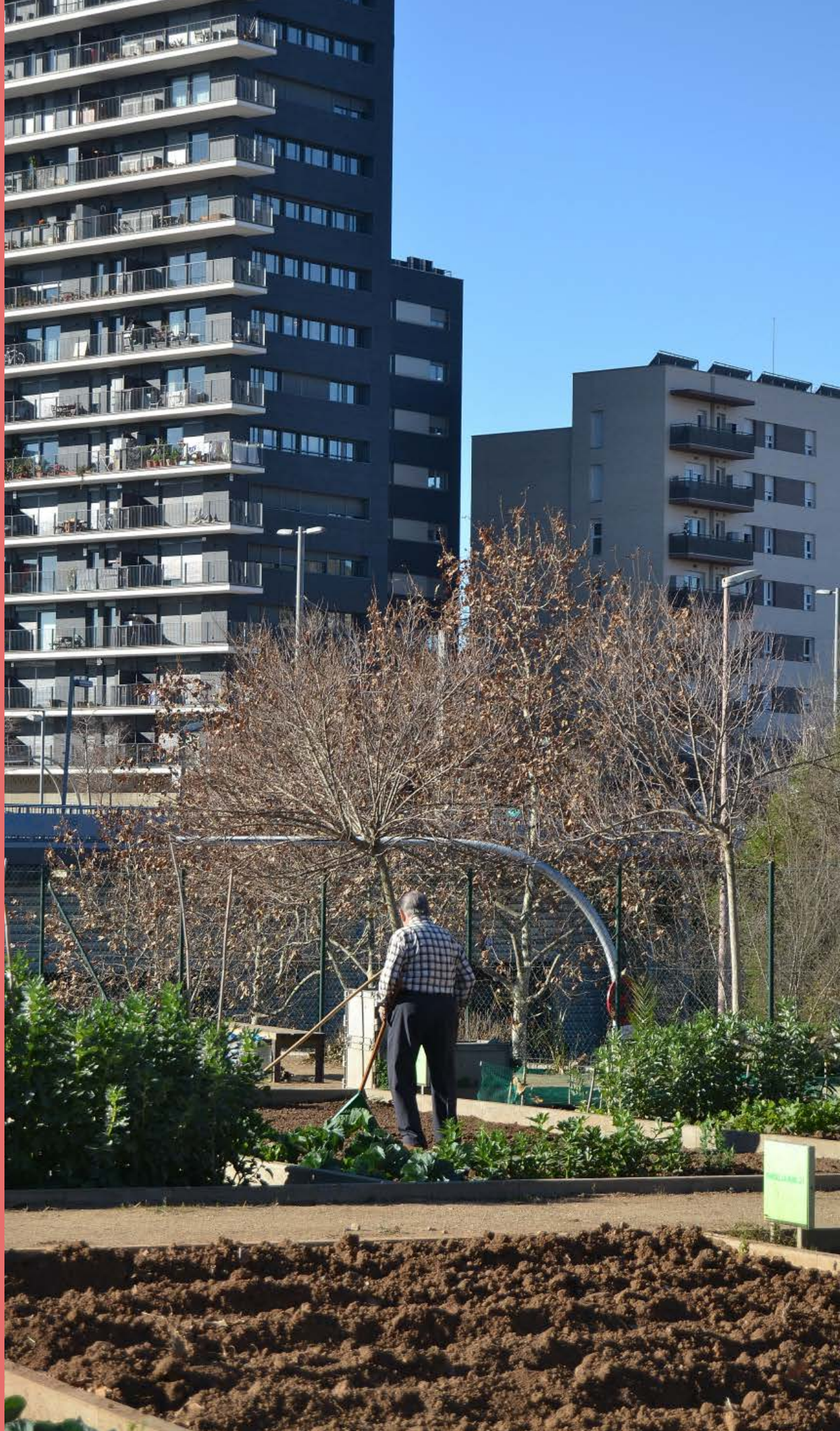
Mediterranean stonecrop (*Sedum sediforme*)

Note that such open environments are becoming extremely useful for many groups of fauna. So, for example, they provide reptiles with a suitable site for sunning themselves. The Catalan wall lizard (*Podarcis liolepis*), the large psammodromus (*Psammodromus algirus*), the ladder snake (*Rhinechis scalaris*) and the Montpellier snake (*Malpolon monspessulanus*) are some of the species that can be found in these environments. Insectivorous birds such as the African stonechat (*Saxicola torquata*) and the streaked fantail warbler (*Cisticola juncidis*) are typical of these environments, not to mention the European goldfinch (*Carduelis carduelis*), the European serin (*Serinus serinus*) and other finches that also use these spaces, especially in the winter, for feeding on the seeds produced by the plants there and which group together in large flocks for that purpose.



Common kestrel (*Falco tinnunculus*)

The common kestrel (*Falco tinnunculus*), a small bird of prey, is also very closely linked to these open environments, which offer it opportunities for feeding on mice, lizards and insects. Kestrels can often be seen hovering in the air as they look for prey.



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Allotments provide rich ecosystems thanks to their wide variety of plants and animals. They are especially useful in urban and peri-urban contexts, given that they offer green-area alternatives to parks and gardens and thereby extend the number of spaces available for developing biodiversity. Allotments attract all kinds of fauna: invertebrates, birds, small mammals etc. The presence of such animals, far from being a nuisance, make a decisive contribution towards the equilibrium of this habitat. So, for example, some birds feed on larvae or insects that are harmful to vegetables. Likewise, amphibians, reptiles and mammals, as well as certain insects - such as ladybirds - help to keep horticultural pests at bay.

To ensure the feasibility of such an equilibrium, a series of basic regulations have to be applied to bring about certain conditions around the allotment which attract fauna: A suitable presence and arrangement of shrubs, fruit trees and ruderal plants at the borders of the allotment will clearly contribute towards achieving this goal. Likewise, we must avoid the use of herbicides and pesticides which can end up introducing toxins into the plants and killing small invertebrates, thereby altering food chains. The interactions necessary for this ecosystem would be weak or non-existent without all these regulations and their derived practices.

Can Cadena



Central role of users

Whether urban allotments are correctly managed depends mainly on users. Municipal workers performing maintenance tasks are also responsible here, though to a lesser extent in such cases: they only work on the plants located around the allotment. Both the former's and the latter's initiatives have to be developed within a coherent framework if the allotment is to benefit as a whole.

The central role of citizens in managing allotments represents a great advantage when it comes to raising awareness of the importance of biodiversity in the city. Barcelona launched a participatory programme at the start of the 1990s aimed at people over the age of 65. The goal was to include them in environmental-improvement activities by cultivating vegetables in a network of 15 urban allotments, following the principles of biological farming. This network is being enriched with eleven allotments located on unoccupied land, managed by organisations from the city, and with other community or family allotments located on courtyards, terraces and balconies, not to mention the more than 200 school allotments that are being developed under the More Sustainable Schools Programme. All in all, it establishes leisure, socialisation and even educational spaces through an activity that had appeared to have almost been forgotten on the urban scene, after the great economic and urban-planning changes of the 20th century.

Urban allotments link the city to its not-so-distant and well-documented past, where farming activities used to occupy the Barcelona plain and a good part of the urban centre. The purpose behind such activities in today's globalised world is to contribute food and, above all, encourage city residents' contact with nature, in a context that promotes civic-minded behaviour and knowledge.



La Trinitat's
allotment

Non-use of herbicides and phytosanitaries to boost the presence of useful fauna in allotments and their borders



Germanetes land plot

Description/application

This is about promoting the presence and development of beneficial fauna populations to combat the pests and diseases that can appear in crops. The phytosanitary state of crops depends to a great extent on the degree of development of such beneficial fauna, which keeps harmful insect populations at acceptable levels through direct predation or parasitism. The success of beneficial fauna depends on many factors, including the development of the environment's vegetation, the crops themselves, climate etc. But the most important factor, however, is to avoid using herbicides and phytosanitary products that have an adverse effect on development.

→ Conserving border plants, grasslands and bramble bushes that are found in allotments and which constitute a reservoir of beneficial fauna.

Green lacewings, for example, are easily recognisable insects given their long, green body, transparent wings with very pronounced nerves, prominent golden eyes and long antennae. They are part of this beneficial fauna of great use for horticulture, seeing as their larvae feed on many of the pests that usually affect allotments (aphids, whitefly, red spider mites, thrips, scale insects and caterpillars). In their adult stage, some species of green lacewings are predators while others, by contrast, feed on nectar and pollen.



Chrysopa (*Chrysopa* sp.)



Can Mestres' urban allotments

The ruderal plants that often accompany urban allotments therefore need to be assessed. Maintaining this type of vegetation helps to boost the allotment's biodiversity and control the crop's pests. In that regard each group of fauna plays its role in controlling the others, so reaching a natural equilibrium in the eco-system. (*See annexe 1: Useful plants for beneficial fauna*).

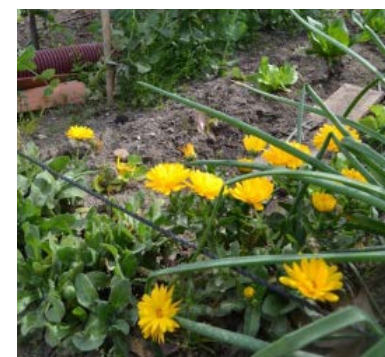
The maintenance work on these border plants is carried out during their dormant period. Where action outside this period is necessary, the flowering period must be avoided and, if bramble bushes are present, the birds' nesting period (March-July).

→ Controlling populations of invertebrate fauna through insectivorous birds and, above

all, bats, which consume large numbers of insects. The allotment must have a plant structure that attracts insectivorous birds and, where possible, nest boxes should be put out for bats. That would increase the eco-system's complexity and contribute to maintaining the natural balance between nature and the various groups of fauna.

→ Planting plant species that attract beneficial fauna, whether within the crops or in the allotment's environment. (*See annexe 1: Useful plants for beneficial fauna*).

→ Uprooting weeds by hand or with the aid of a hoe that appear on the cultivated land. It is advisable to remove such weeds before they seed.



Pot marigold (*Calendula officinalis*)



Camomile (*Matricaria recutita*)



Can Soler's urban allotments

Composting *to have an organic fertiliser that improves the soil's structure and boosts the presence of soil fauna*



Can Soler's urban allotments

Description/application

A whole series of invertebrates are involved in the decomposition process of the organic material, including worms, cockroaches, myriapods and other insects, which, when feeding on such organic matter, break it up into tiny pieces and enable microorganisms, mainly fungi and bacteria, to complete the decomposition process, with humus as the final product. Note that the action of these microorganisms releases nutrients into the soil, which are directly assimilated by plants and, moreover, give rise to a mineralisation process, once the humus is produced, which also ends up helping to increase the soil's fertility. When organic matter is incorporated into the soil, extremely useful soil fauna are also included, whose activity improves the structure of the soil (nutrient-retention capacity, aeration, drainage etc.,) and increases its fertility, while boosting the food chain.

→ Fitting out a place for composters nearby the crops to make it easier to transport the materials. The process for obtaining compost lasts between seven and nine months.



Hort de Torre Melina

Creating shrubby and herbaceous borders *to provide a vegetation that promotes biodiversity*



Hort de l'Avi

Description/application

Ensuring these borders offer a diverse vegetative structure with herbaceous and shrubby plants and, if possible, fruit trees.

The following criteria have to be borne in mind:

- Using native plant species which offer greater interaction with local fauna.
- Creating diversity using several plant species.



Can Mestres' urban allotments

→ Planting trees around allotments to protect crops from wind effects and reduce evapo-transpiration rates, thereby increasing productivity. In addition, mature fruit provide food for many groups of fauna.

(See *Shrub groups and hedges. Annexe 3: Shrubby plants of use to fauna and Urban Allotments. Annexe 2: Border and hedge vegetation*).



Mas Ravetllat's allotments



Can Mestres' allotment

Moderately pruning the environment's shrub layer and lined trees *so the allotment can enjoy the benefits that fauna bring*



Can Mestres' urban allotments

Description/application

Nesting, hibernation, sheltering and feeding places need to be provided for several species of animals, vertebrates and invertebrates alike.

→ The environment's vegetation has to be pruned so plant structures continue to act as a shelter for fauna at all times. Where the large development of such plants require containment action, two initiatives must be planned within a period of five years, so that areas can be maintained without pruning and act as shelter for fauna.

→ Such pruning work, and indeed any maintenance work in general, will be performed during the winter. Where any action is necessary at other times of the year, it will have to avoid the nesting period of the area's birds.

→ Where accumulated rubbish has been spotted, the environment's plants will have to be cleaned. Where the site's features so allow, such cleaning work must avoid any removal of leaves, to encourage the presence of invertebrates in the litterfall.

Ecological farming *to improve the soil's fertility and maintain the ecosystem's natural equilibrium*



Can Mestres' allotment

Description/application

This involves carrying out a series of farming practices that enable improvements to the soil's structure and fertility while also combating outbreaks of pests and disease among the crops. It is therefore advisable to apply them.

→ Intercropping: this involves cultivating several species of plants in the same plot of land while also obtaining a greater yield. (See **annexe 3: Intercropping**).

→ Crop-rotation systems: this involves alternating crop species in the same plot of cultivated land. (See **annexe 4: Crop-rotation systems**).

→ Mulching: this involves covering the cultivated land with a protective layer, preferably made up of organic matter. (See **annexe 5: Mulch and manure**).

→ Contributing organic matter to improve the soil's structure and fertility. By incorporating organic matter into the soil through compost or manure, we are activating its biology, injecting a whole series of fauna (bacteria, fungi and invertebrates) that will take part in the soil-formation process.

Making some plots of land fallow to improve the ecological equilibrium



Can Mestres' urban allotments

Description/application

→ Where possible, strips or plots of cultivated land need to be made fallow for one or several seasons. These plots will be colonised by herbaceous communities that are used for feeding birds, invertebrates and small mammals. Maintenance clearing work has to be carried out on the land plots, where appropriate, bearing in mind, however, that spring flowers are attractive to pollinating insects and become extremely useful for feeding granivorous birds in the autumn.



Can Soler's urban allotments

→ Another option is to plant alfalfa (*Medicago sativa*) or other species from the Fabaceae (legume) family on these plots of fallow land. These legumes have a capacity to capture atmospheric nitrogen and fix it in the soil in such a way that it can be absorbed by plants.

They are able to do that thanks to the presence of small protuberances in their roots known as nodules which house symbiotic bacteria

inside from the *Rhizobium* genus responsible for carrying out this nitrogen fixation. Alfalfa and other legumes (beans, peas, red clover etc.) can therefore be used as a green fertiliser by incorporating the aerial parts of the plants into the soil to improve its fertility. If such plants are used as a green fertiliser, it is advisable to mow them before they flower, as it is then that they contain their highest levels of nutrients.



Nodules in bean roots

Strengthening walls and hollows *to ensure shelters are available for fauna*



Stone wall Can Soler's allotments

Description/application

Care must be taken not to damage elements that can provide shelter for fauna, such as walls, hollows and trunks, which will be used not just by insects, arachnids and other invertebrates but also by lizards and small birds. Where such elements are not present, it may be worth creating walls by piling up stones of different sizes.



Jardins d'Elvira
Farreras Valentí

Boosting the presence of bees *to encourage pollination*



Tres Pins Plant Nursery's apiary

Description/application

Barcelona has two municipally run apiaries that house bees which have been moved from the city's public roads as a result of incidents. Note, in any case, the ecological function carried out by the bees in pollinating plants and crops. It is therefore advisable to boost their presence.

➔ It is a good idea to install apiaries provided this is permitted under the current regulations in force and where the area's ecological features are suitable. The following factors need to be taken into account in apiary sites:

- It is important for apiaries to face south or south-east so they receive the maximum amount of sunshine and temperatures inside the boxes can therefore be maintained. It is also important for the apiaries to be located in areas sheltered from the wind and for the spaces in front of the boxes to be kept clean (free of plants), to enable the bees to easily enter and leave them.

- The boxes should be mounted on benches or other structures to avoid their direct contact with the ground and prevent their bee colonies from being affected by varroa mites (*Varroa destructor*), which parasitise them, and other diseases associated with humidity.
- Apiaries should be positioned in open spaces where there are a considerable number of flowers. It is advisable for such flowers to be under a kilometre away so as to increase the apiary's productivity and prevent excessively long journeys.
- It is also advisable for the apiary to be nearby water points. Bees use water for several purposes, notable among which are feeding their young and the queen and cooling the colony. Where there are no water points, watering troughs can be put up and floating elements added such as cork to protect bees from drowning.

Putting up nest boxes or bat towers *to boost the allotment's natural balance*



Bat-nest tower in the Can Cadena Allotment.

Description/application

A good measure for promoting biodiversity is to put up nest boxes in buildings close to the urban allotments or, failing that, to put up towers specifically designed for these mammals. Bats consume large quantities of insects, given that in a single night they are capable of consuming 60% of their weight in insects and therefore play an important ecological role in regulating insect populations, some of which can become pests to horticultural crops and green spaces in general. On the other hand, they also play a very notable ecological role in eliminating the viruses that are carried by the mosquitoes they feed on. Boosting the presence of bats in the city benefits urban biodiversity and helps to improve public health and well-being.



Bat nest box



Common pipistrelle. Photo: Xavier Puig

USEFUL PLANTS FOR BENEFICIAL FAUNA

SWEET ALYSSUM (*Alyssum maritimum*)



Description: This is an annual herbaceous plant native to the Mediterranean region which spontaneously appears along roadsides. Its flowers are small, white and grouped together in clusters. They can appear throughout the year, though above all in the autumn and winter.

Action: It is advisable to plant it along allotment borders to attract pollinating insects, mainly diptera from the hoverfly family, whose larvae feed on preying aphids. The adults of these flies find an important source of nectar and pollen in sweet alyssum during a complicated time of the year, the autumn-winter period, when there are usually few flowers.

FALSE YELLOWHEAD (*Dittrichia viscosa*)



Description: This is a very rural, semi-woody plant, native to the Mediterranean region and which can be found along roadsides, abandoned fields and turned-over land. It needs no maintenance; in fact, it grows perfectly well in soils that are poor in nutrients and has few water requirements. It is considered a colonising plant, given its leaves' high toxicity, repelling herbivores, and the fact that its roots are capable of secreting phytotoxic substances that prevent other species from establishing themselves nearby. It is advisable, then, to position it along

borders where plants can grow. It presents yellow flowers that appear in the autumn and feed beneficial fauna with their pollen and nectar during a time of the year when food resources are scarce. Its sticky leaves, lending the species its Latin name, provide a strategy for controlling evapo-transpiration, seeing as such stickiness gives the plant a higher resistance to dryness.

Action: False yellowhead is useful for olive and critic tree crops, given that it is used by a species of insect (*Myopsites stylata*), from the same family as the olive fruit fly (*Bactocera oleae*) and the Mediterranean fruit fly (*Ceratitis capitata*) whose larvae grow inside false yellowhead fruit. These larvae are parasitised by a whole series of wasps which in their adult stage parasitise olive and Mediterranean fruit flies and therefore help to keep the numbers of these agricultural pests down to acceptable levels. On the other hand, false yellowhead flowers attract a large number of insects, some of which prey on whitefly, so helping to achieve a natural balance between invertebrate populations.

RAGWORT (*Senecio jacobaea*)



Description: This is a rural plant that flowers during the summer season. Its yellow flowers are grouped in clusters and have a high pollen and nectar content.

Action: It is used as a direct source of feeding for pollinators in general and indirectly for omnivorous predators such as ladybirds and parasitic wasps.

MINT (*Mentha sp.*)



Description: This is a plant that grows from fast-spreading rhizomes under low-light, humid conditions and in rather clayey soils. Its flowers are grouped in blue clusters.

Action: Mint flowers offer a quantity of pollen and nectar that attracts a large variety of insects, from pollinators to predators, not to mention parasitic hymenoptera. It is useful, then, to reserve a shady space for mint inside a piece of cultivated land. They need to be controlled from spreading by being planted, for example, in fruit-tree pits. On the other hand, it has been confirmed that intercropping mint with cabbage within a plot of cultivated land is highly favourable, as the mint's essential oils act as a repellent against the well-known large white butterfly (*Pieris brassicae*), whose caterpillars feed on cabbage leaves.

ROSEMARY (*Rosmarinus officinalis*)



Description: This is a shrubby, perennial plant, native to the Mediterranean region and very useful for flowers. It is clear in that sense that the flowering season of these plants represents a very important factor when it comes to designing strategies for attracting beneficial fauna, and rosemary is a good example of that. Its staggered flowering continues practically throughout the year and offers many possibilities for boosting the presence of beneficial fauna in our crops.

Action: Rosemary is a melliferous plant that not only attracts European honey bees (*Apis mellifera*) but also a large number of pollinators and pest parasitoids. Its flowers also attract predators of thrips and mites which use rosemaries as a plan for sheltering or feeding. Its essential oils act as a repellent for several types of allotment pests, such as whitefly.

COMMON THYME (*Thymus vulgaris*)



Description: A perennial, woody and low-lying plant with leaves that give off an aroma noted for its essential oils. Its whitish-pink flowers blossom in the spring. It is a rural plant perfectly adapted to the Mediterranean climate and grows in full sunshine on rocky and alkaline terrain.

Action: The essential oils in its leaves act as a repellent to several species of insects that are harmful to crops, including aphids, whitefly and large white.

Thyme also attracts a whole series of pollinating and parasitoid insects. Some of these parasitoids are solitary adult wasps

whose diet consists of pollen and nectar; but when they feed their offspring, they then capture a variety of invertebrates such as grasshoppers and caterpillars, which they take to their nests (normally on the ground) and use for feeding their larvae offspring.

BORAGE (*Borago officinalis*)



Description: Annual plant typical of borders, allotments, grasslands and damaged environments, used since ancient times as a vegetable. It flowers in the spring.

Action: Borage is especially attractive for pollinating insects, as it is regarded as one of the most melliferous plants in the Mediterranean region. Its flowers have a high nectar content that attracts pollinators such as honey bees as well as parasitoid hymenoptera and generalist predators of insects that are harmful

to our crops. In that regard, it is one of the best plants for accompanying our crops given its powers in attracting beneficial fauna.

VIPER'S BUGLOSS (*Echium vulgare*)



Description: Annual plant native to the Mediterranean region that can be found along roadsides and damaged land. It derives its common name from its fruit's resemblance to the head of a viper.

Blossoming in the spring, its blue flowers attract a large number of pollinating insects.

Its toxicity gives it a defence mechanism against herbivores and phytophagous insects.

Action: The high content of pollen and nectar in its flowers attracts a large number of pollinating insects as well as a whole series of arachnids, which make up one of the most important groups in regulating the biological populations of pest insects that can affect our crops.

OTHER PLANTS THAT ATTRACT USEFUL FAUNA INCLUDE:

- **Basil (*Ocimum basilicum*)**

It attracts bees and repels tomato whitefly.

- **Dill (*Anethum graveolens*)**

It attracts hoverflies.

- **Aster (*Aster sp.*)**

This attracts green lacewings, whose larvae feed on several species of aphids, thrips, scale insects and caterpillars, as well as the eggs of various species of insects. Adult green lacewings can be predators, otherwise they feed on nectar and pollen.

- **Cleavers (*Galium aparine*)**

This repels greenfly (from the family Cicadellidae) which often attack aromatic plants such as rosemary and thyme.

- **Wild angelica (*Angelica sylvestris*)**

It attracts insects from the family hoverfly. Its larvae prey on aphids whereas its adults are pollinators.

- **Marigold (*Calendula officinalis* and *Calendula arvensis*)**

This attracts parasitoid hymenoptera such as wasps, which parasitise several species of aphid. Its flowers contain nectar and therefore attract a large number of pollinating insects such as bees. It also repels nematodes.

- **Prostrate Canary clover (*Dorycnium pentaphyllum*)**

Its flowers' melliferous content attracts numerous pollinating insects.

- **Garden nasturtium (*Tropaeolum majus*)**

It is a good idea to plant garden nasturtium in fruit tree pits or among allotment plants as they act as repellents against aphids, whitefly, true bugs, snails and nematodes. It attracts pollinating insects.

- **French marigold (*Tagetes patula*)**

It can be planted between horticultural plants and fruit trees to protect against nematodes and attract green lacewings.

- **Lavender (*Lavandula sp.*)**

This attracts pollinating insects and repels pests such as rose bush aphids.

- **Fennel (*Foeniculum vulgare*)**

It attracts insects from the hoverfly family.



Garden nasturtium (*Tropaeolum majus*)



Pot marigold (*Calendula officinalis*)



Camomile (*Matricaria recutita*)



French marigold (*Tagetes patula*)

- **Hyssop (*Hyssopus officinalis*)**

This repels caterpillars, aphids and snails. Its flowers' nectar attracts numerous pollinating insects such as bees and butterflies.

- **Camomile (*Matricaria recutita*)**

This attracts hoverflies and bees. A great producer of pollen.

- **Yellow rest-harrow (*Ononis natrix*)**

This is a melliferous shrub that attracts many pollinating insects. It attracts beneficial fauna such as true bugs, some of whose species prey on pests. It can also be used as a host plant for pests such as aphids. It is therefore a good idea to plant this species in allotment borders seeing that it draws pests over to it, thereby protecting horticultural plants from them, on the one hand, and, on the other, attracts predators of pests, such as ladybirds and lacewings.

- **Field milk thistle (*Sonchus arvensis*)**

Its flowers attract numerous pollinating insects. It acts as a crop-pest host plant.

- **Marjoram (*Origanum majorana*)**

Its flowers attract bees and butterflies.

- **Lemon balm (*Melissa officinalis*)**

Its flowers attract bees.

- **Yarrow (*Achillea millefolium*)**

This is a good plant for attracting useful fauna such as hoverflies (which prey on aphids) and green lacewings. Its flowers attract bees, among other things. It stimulates the production of essential oils in aromatic plants.

- **Wild carrot (*Daucus carota*)**

Its flowers produce a nectar that attracts hoverflies which prey on aphids and whitefly.

- **Rue (*Ruta graveolens* and *Ruta chalepensis*)**

It repels aphids, slugs, flies, mosquitoes and nematodes, among other things. Its flowers attract hoverflies.

- **Sage (*Salvia officinalis*)**

Its flowers attract honey bees and bumblebees. It can be planted among cabbages given its repellent properties against large white butterfly (*Pieris brassicae*) caterpillars.

Source: Bichelos, Control Biológico S.L. www.bichelos.com



Hyssop (*Hyssopus officinalis*). Photo: Wikimedia



Sage (*Salvia officinalis*)



Lemon balm (*Melissa officinalis*)



Daisies (*Aster* sp.)



Fennel (*Foeniculum vulgare*)

BORDER AND HEDGE VEGETATION

Shrubs	Associated fauna
Blackthorn (<i>Prunus spinosa</i>)	Its fruit is eaten by birds. Its nectar-producing flowers attract butterflies, bees and other insects.
Common lilac (<i>Syringa vulgaris</i>)	Its flowers attract insects.
Laurustinus (<i>Viburnum tinus</i>)	Its fruit is eaten by birds. Its flowers attract insects.
Common dogwood (<i>Cornus sanguinea</i>)	Its fruit is eaten by birds.
Elderberry (<i>Sambucus nigra</i>)	Its fruit is eaten by birds. Its flowers attract insects.

Bramble bushes and low scrub	Associated fauna
Elmleaf blackberries (<i>Rubus ulmifolius</i>)	It provides nesting and food for several species of birds and is also used as shelter by several groups of fauna (invertebrates and vertebrates alike).
Wild asparagus (<i>Asparagus acutifolius</i>)	This attracts insects.
Butcher's-broom (<i>Ruscus aculeatus</i>)	Its fruit is eaten by birds. Its flowers attract butterflies and other insects.
Dog-rose bush (<i>Rosa canina</i>)	Its fruit is eaten by birds. Its flowers attract butterflies and other insects.
Evergreen rose bush (<i>Rosa sempervirens</i>)	It provides nesting and food for several species of birds and is also used as shelter by several groups of fauna (invertebrates and vertebrates alike).

Lianas	Associated fauna
rough bindweed (<i>Smilax aspera</i>)	Its fruit provides food for birds.
Common ivy (<i>Hedera helix</i>)	It provides nesting and food for several species of birds and is also used as shelter by several groups of fauna (invertebrates and vertebrates alike).
Fragrant virgin's bower (<i>Clematis flammula</i>)	This is used as a shelter by many invertebrates.
Common grape vine (<i>Vitis vinifera</i>)	Grapes are the food for many invertebrates and vertebrates.

Grasses	Associated fauna
Mediterranean false-brome (<i>Brachypodium retusum</i>)	Several species of granivorous birds feed on its seeds. Its flowers attract insects.
Common thistles (<i>Cirsium vulgare</i>)	Several species of granivorous birds feed on its seeds. Its flowers attract butterflies and other insects.
Wall barley (<i>Hordeum murinum</i>)	Several species of granivorous birds feed on its seeds. Its flowers attract insects.
White rocket (<i>Diplotaxis eruroides</i>)	Several species of granivorous birds feed on its seeds. Its flowers attract insects and other invertebrates.

Source: “Manual for conserving biodiversity in agrarian habitats”.
Generalitat of Catalonia Catalan Environment and Housing Ministry.

INTERCROPPING

There are plants that help one another when they are put in contact, referred to as **positive associations**, and others that harm one another, whether by direct competition or because the roots of some plants secrete substances that have an adverse effect on the growth of the plants they share their spaces with, referred to as **negative associations**.

So, for example, there are well-known positive associations between vegetables and certain aromatic plants which help to keep undesired insects at bay, thanks to the repellent action of their essential oils. Such is the case with basil (*Ocimum basilicum*) and rue (*Ruta graveolens*), which protect against proliferations of aphids on tomatoes and peppers. And with French marigold (*Tagetes patula*), which repels aphids and whitefly. In this case it has a triple action: its aroma repels whitefly; its roots release chemical repellents and its nectar attracts ladybirds, hoverflies and wasps, which prey on aphids and their larvae.



Parsley
(*Petroselinum
crispum*)

Parsley (*Petroselinum crispum*) which also repels whitefly. So it is also a good idea to plant some in the plot of land being cultivated.

The goal then is to make the most of the inter-relations between plants and between plants and animals and of the plot of land being cultivated under the following criteria:

→ **Optimising space:** this increases plantation densities and uses plants of a different structure (vertical-growth crops and horizontal-growth crops) in such a way as to enable better soil cover and better harnessing of sunlight while keeping the land's humidity constant.

Examples: Maize + squash, climber beans + cucumbers.

→ **Time optimisation:** horticultural short-lifecycle plants are grown in free spaces left by long-lifecycle plants. Examples: lettuces + tomato plants, cabbages + broad beans.

• **Plants with supplementary nutritional needs or different root systems.** These allow the most to be made of the soil's nutrients. Examples:

• Cabbages and cauliflowers intercrop well with broad beans, peas or string beans. Legumes introduce nitrogen into the soil, which helps the vegetative part of the other species to grow.

• If we intercrop carrots and lettuces, the former will grow in 50 cm of soil, absorbing mainly potassium, while the roots of the latter will grow in the first 30 cm in search of nitrogen. Note:

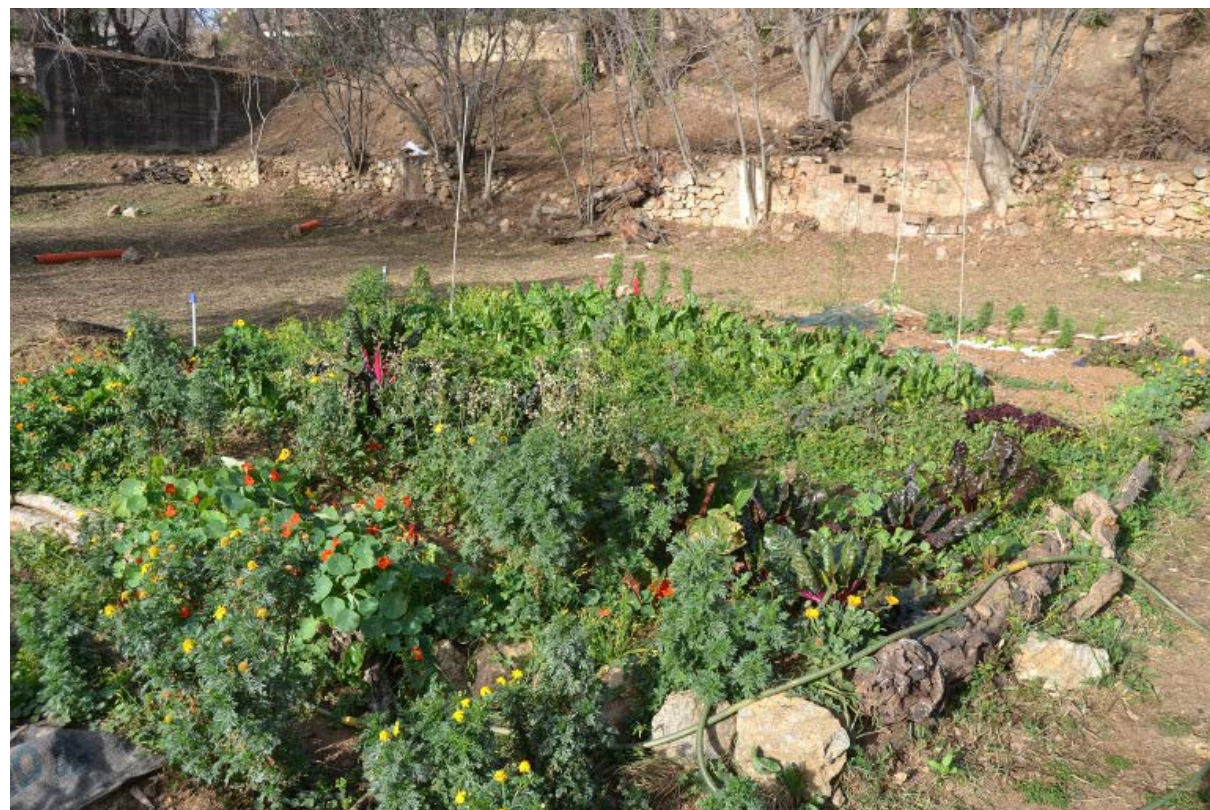
- Root vegetables: require potassium.
- Leaf vegetables: require lots of nitrogen to grow large and healthy leaves.
- Fruit vegetables: need phosphorus for producing large and tasty fruit.



Can Mestres' urban allotment



Can Mestres' urban allotment



Mas Ravetllat

➔ **Intercropping with legumes:** nitrogen fixation.

Examples: it is also usual to plant string beans, maize and squash on the same plot of land. String beans introduce nitrogen to the soil, maize is used as a growing guide for the string beans, whereas the squash carpets the soil and keeps it at a constant level of humidity thanks to the shade it casts.

Useful plants intercropping crops for obtaining phytosanitary advantages:

- Bait plants: are more attractive than their intercropped plants to a specific pest.
- Protective plants: act as a shelter or source of food for useful fauna, thereby boosting their presence and activities.
- Repellent plants: release pest-repelling substances.

Table of various protective and repellent plants:

Plant	Beneficial effects
Basil	General insect repellent
Camomile	Attracts pest-parasite hymenoptera
Garden nasturtium	Controls whitefly
French marigold	Repels nematodes, aphids and whitefly. Also attracts hoverflies, wasps and ladybirds by producing nectar.
Common flax	Repels Colorado potato beetles
Mint	Controls ants and cabbage white fly
Sage	Repels large whites and carrot flies

Table of various protective and repellent plants:

Plant	Beneficial effects
Aubergine	Colorado potato beetles show a preference for this plant over potato crops.
Maize	Given the preference that the scarce bordered straw (<i>Helicoverpa armigera</i>) has for it over tomato plants, it can be used with the latter's crops.
Tree tobacco	Attracts numerous pests. (Make sure it is planted in greenhouses, as it can be a source of powdery mildew).

Source: "Practical guide to ecological horticulture: school allotments".
Barcelona City Council.Schools Agenda 21.

CROP-ROTATION SYSTEMS

Crop rotations help to maintain the balance of nutrients in plots of cultivated land and make it hard for pests and diseases to establish themselves, as crops are not repeated from one season to another. In any case, crop-rotation systems require the cultivated area to be organised into four completely bounded plots. There are basically two types of crop rotations:

Botanical families

This involves establishing a plantation calendar for each plot in four-year cycles, grouping together annual plantations for botanical families. Each botanical family presents various nutritional requirements so that if we do not repeat a plantation in a plot for a period of four years we can keep the soil fertile.

This is the system proposed under Gaspar Caballero de Segovia’s Parades en Crestall method.

Plot	First year	Second year	Third year	Fourth year
1	Nightshades	Legumes - Crucifers	Composites Chenopodiaceae Gourds	Umbelliferae Liliaceae
2	Umbelliferae Liliaceae	Nightshades	Legumes Crucifers	Composites Chenopodiaceae Gourds
3	Composites Chenopodiaceae Gourds	Umbelliferae Liliaceae	Nightshades	Legumes Crucifers
4	Legumes Crucifers	Composites Chenopodiaceae Gourds	Umbelliferae Liliaceae	Nightshades

Source: "Practical guide to ecological horticulture: school allotments".
Barcelona City Council. Schools Agenda 21.

So, **plot 1** will only have an annual plantation established, at the start of the spring, with long-lifecycle plants. Even so, the land can be prepared in the winter for purposes of its gradual fertilisation.

Plot 1	
Nightshades	Tomatoes, peppers and aubergine

Plot 2 can have several harvests of carrots and onions given their very short life-cycle while the other crops will only be harvested once.

Plot 2	
Umbelliferae	Carrot, celery and parsley
Liliaceae	Onions, leaks and garlic

Plot 3 can have spinach or Swiss chard sown in the autumn, given their long lifecycles; several harvests of lettuce and, once the good weather arrives, cucumbers and courgettes.

Plot 3	
Composite	Lettuce and common chicory
Chenopodiaceae	Swiss chard and spinach
Gourds	Cucumber and courgette

Finally, **plot 4** can have broad beans and peas sown at the start of the winter and cabbage and cauliflower too, in the autumn.

Plot 4	
Legumes	String beans, peas and broad beans
Crucifers	Cabbage, cauliflower, broccoflower and radish

The crops will be rotated the following year, with the plantations made in plot 1 moving to plot 2; those in plot 2 to plot 3; those in plot 3 to plot 4 and those in plot 4 to plot 1.

Nutritional requirements

The second method proposes a four-year rotation based on the nutritional requirements of each type of plant, taking into account that some have very high needs and others have average or low needs, and that some crops improve the soil's fertility.

Plot	First year	Second year	Third year	Fourth year
1	High	Average	Low	Soil-improving crops
2	Average	Low	Soil-improving crops	High
3	Low	Soil-improving crops	High	Average
4	Soil-improving crops	High	Average	Low

Plants with high nutritional requirements
Tomatoes, potatoes, squashes, courgettes, cucumbers, maize, asparagus, Swiss chard, celery, cabbage, cauliflower, artichokes, strawberries, leaks and parsley.

Plants with average nutritional needs
Aubergines, carrots, onions, spinach, lettuce, peppers, melons, watermelons, garlic, radish, parsnip and beet.

Plants with low nutritional needs
Common chicory, string beans, broad beans, lentils, peas, chick peas and soya.

Soil-improving crops that contribute nitrogen to the soil
Green fertilisers: clover, comfrey or alfalfa.

Source: "Practical guide to ecological horticulture: school allotments".
Barcelona City Council. Schools Agenda 21.



Onions in Can Soler



Trinitat allotment



Swiss chard in Mas Ravetllat

MULCH AND MANURE

Mulch

Materials	Decomposition capacity	Layer thickness	Comments
Mulched pruning leftovers	Low	5 cm	
Mashed leaves and dry grass	Average	3-5 cm	
Mowed lawn, green leftovers from allotments	High	1 cm	Applied to the surface and, after 5 to 10 days have passed, mixed with the first 5 cm of the soil
Straw	Very low	2-3 cm	Recommended for avoiding excess humidity at the base of stems
Compost	Very high	2-3 cm	Improves the structure of the soil

It should be noted that the European beach, pin and other conifer tree leaves acidify the soil, so it is not advisable to use such materials for mulching, except where acidophilic plants are being cultivated.

Nor is it advisable to using mulch on plots of cultivated land in the following cases:

- Where the sowing has to be done directly. The seeds here need bare earth and good exposure to sunlight. No mulching then until the seeds have germinated and their plants have grown a few centimetres in height
- In cold and humid areas where the cultivated land needs to be capable of being warmed up by sunshine.
- In areas of light and scarce rain, where good irrigation systems are unavailable, what little precipitation there is only dampens the organic mulch and fails to enter the soil.

Manure

Types of manure	Features	Dose	Comments
Sheep	Very rich and balanced in nutrients	0.5-2 kg/m2	Has to be fermented to eliminate seeds and pathogenic agents. When fresh, it can burn plants.
Goat	Similar to sheep manure but stronger	0.5-2 kg/m2	Has to be fermented before it is applied or mixed with horse manure to make it milder.
Hen droppings	Very rich in nitrogen and very strong. Contains a high quantity of calcium and is therefore not suitable for use in calcareous soils. Very good in acid soils	0.05.-0.3Kg/m2	Has to be fermented and only used in small quantities to avoid burning the plants. It is better NOT to use intensive-farming manure (which contains anti-parasites, anti-biotics etc.)
Rabbit	This is a strong manure, where used fresh, and quite acidic.	0.1-0.4 kg/m2	It has to be properly fermented. It can be mixed with straw and leaves for better fermentation. Where soil is applied to it, it is better to do that in the autumn so it can be worked up to the spring.
Horse, donkey or ass	A good manure, with large quantities of microorganisms and quickly ferments, though a little poor in nutrients. Rich in water	1-5 kg/m2	Ideal for mixing with other manures such as sheep dung or hen droppings. Goes very well on clayey soil as it makes it spongy.

Source: "Practical guide to ecological horticulture: school allotments".
Barcelona City Council. Schools Agenda 21.



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Aquatic ecosystems in nature play an environmental role of the first order, such as providing water for the land and subsoil and creating habitats for numerous species of plants and animals. Humid areas are considered one of the richest ecosystems in biodiversity and play a notable role in preserving amphibians, which are dropping in numbers all over the planet.

When it comes to urban environments, naturalised aquatic milieus - and ponds in particular - provide a highly valuable, ecological habitat which, for all the limitations expected of their location, make a notable contribution towards maintaining and boosting biodiversity in the city. Barcelona boasts over two hundred ponds and aquatic milieus that are linked to parks and gardens. It is a whole series with a large diversity of types relating to size, location and extent of naturalisation. There are large ones, such as the pool in the Parc de la Ciutadella and more modestly sized ones scattered throughout parks, gardens and squares, in every neighbourhood and district. Some eighty ponds and ornamental fountains in the city are currently following a naturalisation programme aimed not only at achieving a natural balance in fauna and flora but also at making those very aquatic systems self-regulating while boosting their biodiversity.

Naturalisation

Such diversity demands specific attention to the uniqueness of each case. Even so, there are general ideas on good management. The first is to carry out a type of moderate cleaning that changes the habitat as little as possible. Naturalising ponds guarantees biodiversity and provides a management alternative to chlorination. Both the orderly aspect expected by the public and the space's natural balance have to be addressed.

Another key aspect of management involves monitoring the space's plant and animal communities and paying special attention to those that can adversely affect the ecosystem. All food levels must be represented there if a mature and complex ecosystem is to be achieved. Hence the importance of preserving algae, invertebrates, plants and, above all, amphibians (some of which are protected species) and, on the other hand, of controlling exotic species that harm the habitat, such as carp, goldfish and pond sliders. The balance concept also applies to organic matter, whose presence is necessary for life, only up to a certain point, but whose excess causes a reduction in oxygen levels and a drop in biodiversity.

Outside space

The space located around pools or ponds is important because of its direct influence on the quality of the aquatic environments. Note that amphibians develop in two habitats. The presence and availability of lined trees or shrubs as well as other elements -walls, rocks, plant pots, plant cover etc., - can encourage biodiversity by creating shelters and continuity spaces between water and land, promoting the interaction required for all ecosystems.

Gardening work therefore has to be adapted to these needs.

Ponds and aquatic environments are always a point of special attraction for visitors, which is why they make an ideal place for highlighting how ecological values are being added to aesthetic values and strengthening them. Views of flora are enriched when they include fauna. A complete aquatic habitat can attract more animals from other sites, such as birds, which make viewings even more of a pleasure by bringing quality sounds to the landscape.

Turó Park's small pond



Cleaning ponds and minimising the impact on habitats to prevent their destruction



Turó Park's small pond with filamentous algae (genus *Cladophora*)

Description/application

→ Has to be annually cleaned during its period of least biological activity (November to February).

- Such action will involve:
- Removing organic matter.
 - Removing filamentous algae.
 - Removing or controlling exotic fauna populations.

Filamentous algae proliferations will probably require more frequent cleaning initiatives. In such cases action will be taken where appropriate, except during the period between April and July, which corresponds to the amphibians' breeding period, as the filamentous algae may contain their eggs.

January	●
February	●
March	
April	●
May	●
June	●
July	●
August	
September	
October	
November	●
December	●

- Annual cleaning
- Amphibians' breeding

→ It is important to make the most of the annual cleaning to ensure the aquatic plants are maintained, divided and planted. (See *annexe 1: Aquatic plants at the Tres Pins Plant Nursery*).

→ Ponds have to be emptied once a year for cleaning and maintenance work, while preserving their biota and returning it to the pond, as established under Area of Environment Instructions IA/02.02: Managing fauna in ornamental fountains. Note, however, that a thorough monitoring throughout the year, by controlling the various factors that can disrupt the balance of the pond, may make it unnecessary to empty out the pond every year.

→ Avoid removing all the pond's sediment, to encourage muskgrass (*Chara sp.*) to take root, a native alga of very useful ecological value.



Installing flower boxes in the Can Cadena's pond



Surface cleaning the Monestir de Pedralbes' irrigation pond

Controlling excess organic material in ponds *to protect against eutrophication and bad smells*



Cleaning of the Turó Park's water lily pond

Description/application

An aquatic system's organic matter decomposes through the activity of the water's microorganisms (mainly fungi and bacteria). The end result of this process is the release of nutrients into the environment. Excess organic matter raises the concentration of nutrients dissolved in the water (eutrophication), put at the disposal of algae and other organisms which quickly use them, making their populations grow enormously. On the one hand, the activity of all these organisms consumes oxygen, thereby depleting the water's oxygen and giving rise to anoxic conditions (lacking oxygen) that are in turn responsible for the creation of toxins and bad smells. On the other hand, the excessive growth of the filamentous algae blocks the entry of light, impeding the aquatic plants' photosynthesis. So a pond's load capacity for processing a certain concentration of organic matter must not be exceeded.

→ Surface litterfall has to be removed every week with a scoop net. Organic leftovers from food also have to be looked out for and removed.

→ Visitors must be prevented from feeding pond fauna (increased organic matter). Warnings should be bolstered with signage.

→ Trees should not be planted near toy ponds so their leaves do not fall in them. If there are already trees there, they must be suitably pruned.

Where these are deciduous trees, it is worth considering the option of putting up a net during the period they shed their leaves.

→ Natural (plant) or artificial structures need to be put up to block organic matter from entering ponds.

Llac de Diagonal Mar with goldfish inside



Controlling or eliminating exotic species to avoid adverse effects on native fauna and the ecosystem



Goldfish (*Carassius carassius*)



Pond sliders (*Trachemys scripta*)

Description/application

Where there are amphibians in such naturalised ponds, their populations of carp (*Cyprinus carpio*), goldfish (*Carassius carassius*), pond sliders (*Trachemys scripta*), red swamp crawfish (*Procambarus clarkii*), eastern mosquitofish (*Gambusia holbrooki*) and generally any exotic species that may adversely affect these ecosystems will have to be removed. Where naturalised ponds do not have any amphibians, the proposal is to control their populations of carp, goldfish and pond sliders through periodic culling, to keep their population down to 10%-15%.

→ Exotic species have to be removed. This must be done as specified under Area of Environment Instruction IA/02.02: Managing fauna in ornamental fountains.

→ These exotic species have to be removed from ponds as soon as possible.



Grey heron (*Ardea cinerea*). Laberint d'Horta's wash house

→ Where no naturalisation programmes are permitted in such ponds, because of their features and urban context, one option is to maintain their exotic fauna. The Parc de la Ciutadella's large lake and the Laberint d'Horta's wash house offer good examples of that. Species such as grey herons (*Ardea cinerea*) use them as feeding points.

Despite the option for conserving gold fish or pond slider populations in certain ponds, the fact is that their presence is very harmful to the pond's biodiversity, as these animals have a very pronounced predatory behaviour and eat amphibian eggs, small tadpoles, aquatic invertebrate and, in the case of fish, zooplankton.

They also adversely affect the quality and transparency of the water, by eliminating zooplankton and by increasing organic matter concentrations with the urine and excrement they produce during their activity. In addition, by moving along the bottom of the pond, they stir up its sedimentary materials, thereby releasing sedimented nutrients and spreading them throughout the water column. Once they reach the surface, these nutrients lead to uncontrolled growth of bacterial and unicellular and filamentous algae populations, making the water considerably murkier.

It can therefore be said that the presence of fish and turtles is incompatible with any kind of pond-naturalisation programme, one of whose precise goals is to boost the biodiversity of these aquatic systems in accordance with certain water quality and transparency parameters required by the urban context they are set in.



Monestir de Pedralbes' pond with goldfish inside

Ensuring a balance of fauna in the ecosystem to preserve habitats and biodiversity



Female wild duck and ducklings in the Palau Reial's lake.
Photo: Xavier Ferrer



Cat by the Tres Pins Plant Nursery's pond

Description/application

→ Special care has to be taken with cat colonies near to naturalised ponds to prevent them from preying on adult amphibians. In fact, predation by domestic cats is one of the main threats to the urban biodiversity, not just of amphibians, but also and especially of reptiles, birds and small mammals.

It is therefore advisable to move such cat colonies to other locations and, where that cannot be done, the colony's feeding points should be kept as far as possible from the pond.

→ Special attention should also be paid to the presence of ducks in naturalised ponds. They adversely affect amphibian populations when they feed on algae that very often contain hidden eggs or tadpoles, above all during the amphibians' breeding season (April to July). They also affect the quality of the aquatic plants by feeding directly on them or using them as resting platforms. Finally, they adversely affect the quality of the water given that they soil it. The presence of ducks is also associated with the entry of organic matter (bread and food given by visitors) which cause serious imbalances in the ecosystem.

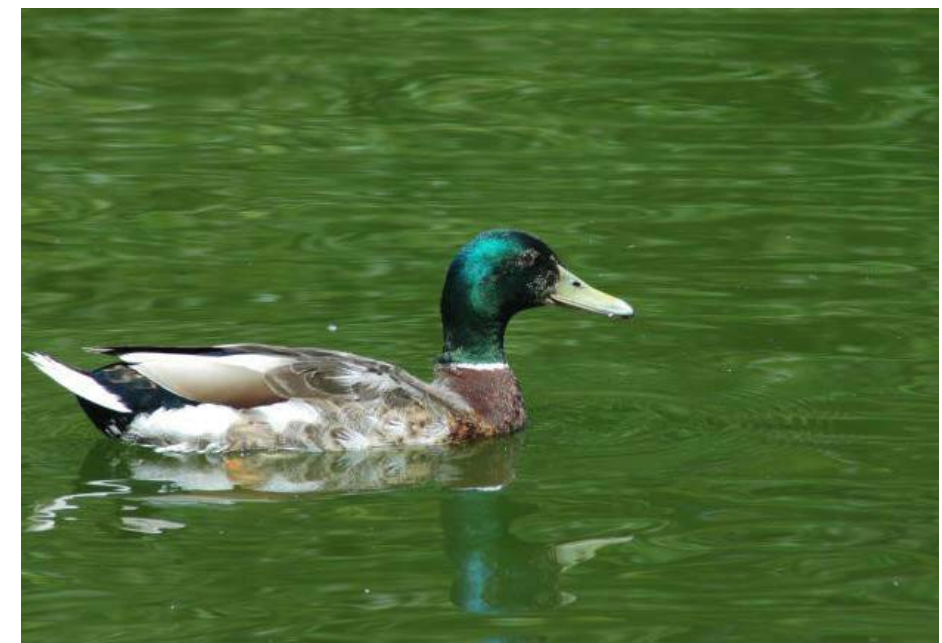
Where ducks upset the balance of the system, it is advisable to capture them and transfer them to agreed areas.

Where there are game species involved, such as wild ducks (*Anas platyrhynchos*), authorisation for capturing them will have to be requested from the Territorial Services at the Catalan Ministry of Agriculture, Livestock, Fishing and Food at the Generalitat of Catalonia.

→ Native species can be found in naturalised urban ponds that are not from these environments, such as Spanish pond turtles (*Mauremys leprosa*), European pond terrapins (*Emys orbicularis*) and even various species of fish. They are there as a result of having been re-introduced or abandoned and not by natural colonisation. In such cases these animals will be transported to the Catalan Amphibian and Reptile Recovery Centre (CRARC).



Yellow-legged gulls (*Larus michahellis*) have been seen preying on adult Iberian waterfrogs (*Pelophylax perezi*) in the Jardins de Mossèn Cinto Verdaguer's ponds.



Male wild duck in the Palau Reial's lake. Photo: Xavier Ferrer

Not applying phytosanitary or chemical products *to preserve the ecosystems' natural processes*



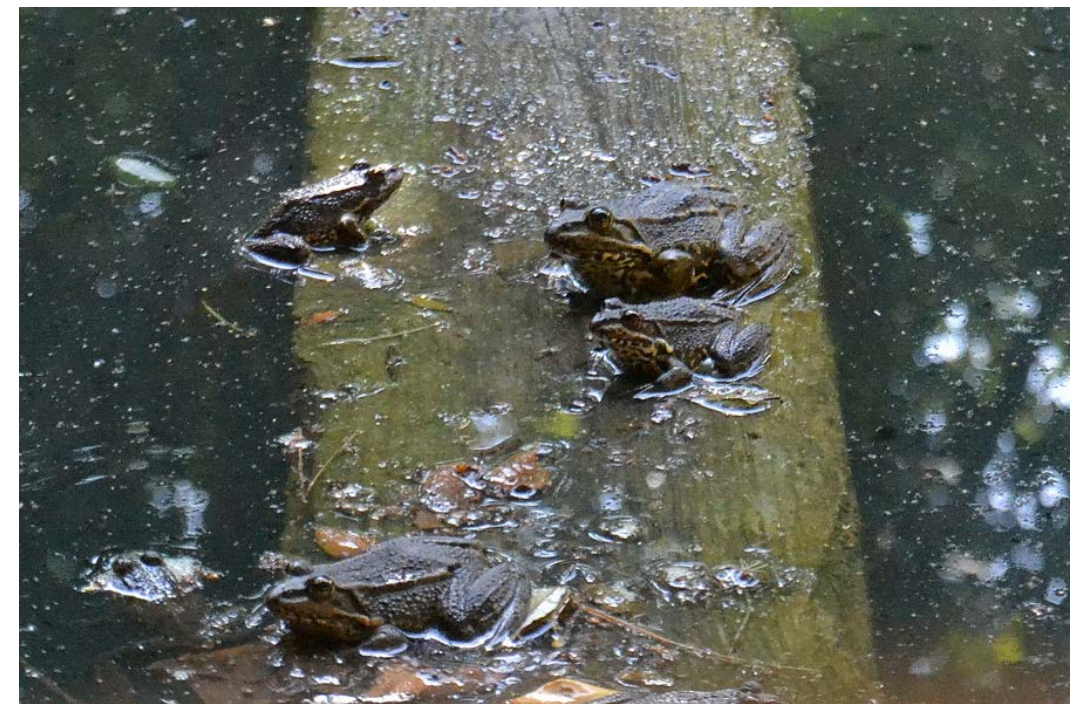
Water lily (*Nymphaea* sp.)

Description/application

Phytosanitary or chemical products must not be used for controlling algae populations or when pests appear in aquatic plants. Water chlorination must also be avoided. To do so would mean altering the physical and chemical properties of the water and would thereby kill the tadpoles and aquatic invertebrates found in the pond.

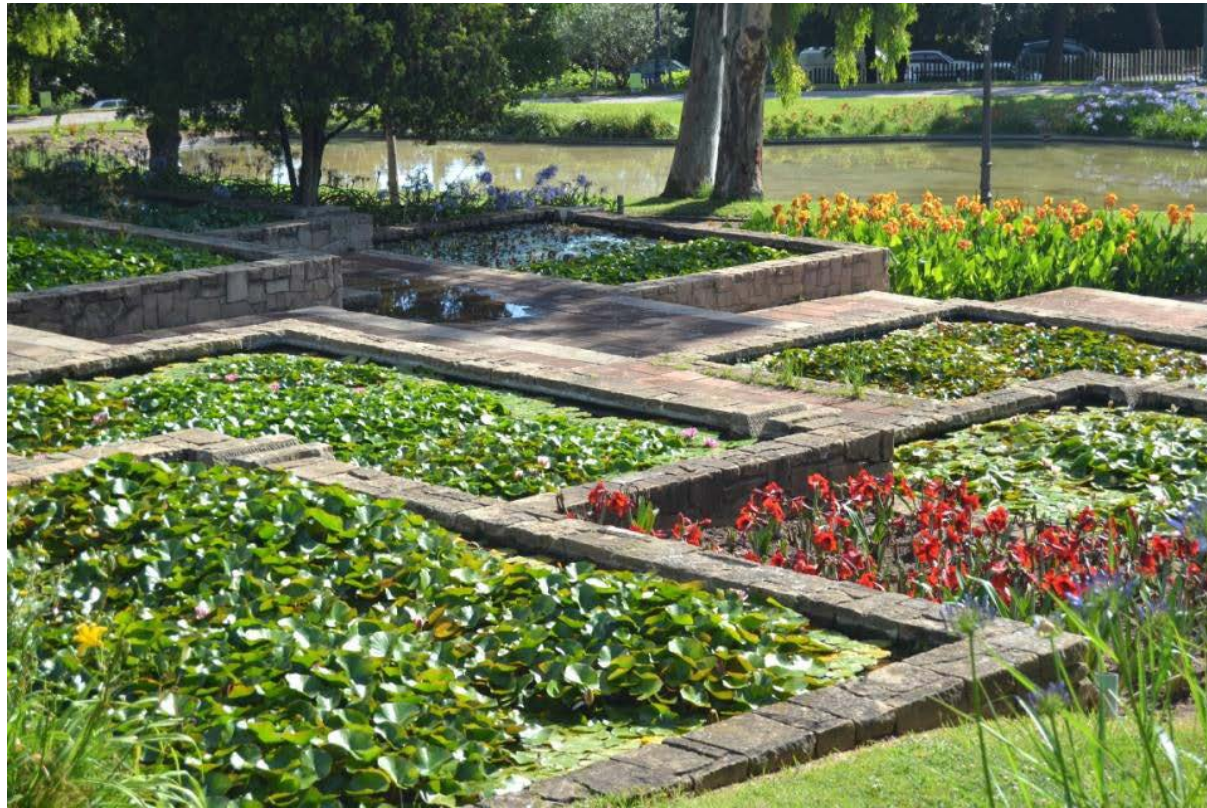


Pontederia cordata



Iberian waterfrog (*Pelophylax perezi*)

Boosting invertebrate fauna in ponds *to control mosquito-related problems*



Jardins de Mossèn Cinto Verdaguer

Description/application

A properly constituted, fully biologically performing pond contains a whole series of invertebrate and vertebrate fauna that keep the water system's mosquito larvae under control and therefore considerably reduce the presence of winged adults in the pond's vicinity.

This beneficial action is due to the presence of a whole series of species of invertebrates which, like mosquito larvae, are detritivores (feed on organic matter) and which therefore exploit the same resource, so reducing the availability of food at the mosquito larvae's disposal. Tadpoles, aquatic snails, water fleas and mayfly larvae, among other species, are detritivores that compete with mosquito larvae.



Iberian bluetail (*Ischnura graellsii*)



Dragonfly larva

→ On the other hand, water bugs, also known as backswimmers, dragonfly larvae and Iberian bluetails and three amphibian species (common midwife toads in particular) prey directly on mosquito larvae. Furthermore, a large number of aquatic insects that leave the water in their adult stage and fly around the pond area attract numerous insectivorous birds and bats, which feed on adult mosquitoes. It is not true, then, that the only way to keep mosquitoes at bay in a pond is by introducing fish.

→ Tiger mosquitoes (*Aedes albopictus*) do not use large sheets of water as egg-laying habitats, but show a preference instead for scuppers, irrigation boxes and other points that accumulate standing water, such as irrigation plates and tank lids. In any case, being active during the day and low flying, insectivorous birds, dragonflies and Iberian bluetails make up their only predators.



Common midwife toad (*Alytes obstetricans*) tadpole

There is a need, then, to boost their presence by offering a useful plant structure around the pond that enables insectivorous birds to find protection and nesting substrates; and, on the other hand, egg-laying substrates ought to be strengthened for dragonflies and Iberian blue-tails, using aquatic plants.

➔ If mosquito larvae are to be kept away from ponds, it would be useful for the latter to have a water fountain whose jet of water creates movement over the sheet of water's surface layer. This will break the water's surface tension and prevent mosquitoes from using the pond as an egg-laying substrate, given the water's constant movement. It is important, however, for the movement of the water to extend to every nook and cranny of the pond and thereby avoid creating stagnant water areas capable of being used by mosquitoes. In this regard, fountains which give off rain-like jets of water will ensure a continuous trickle over the entire surface of the pond and prove to be truly effective.



Naturalisation of the Can Cadena's irrigation pool



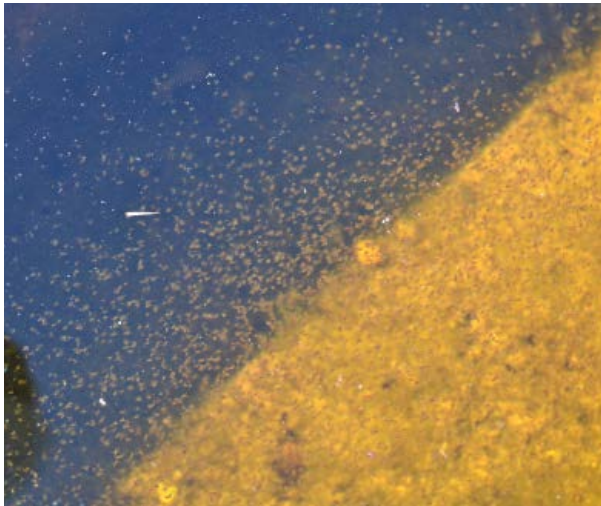
Movement of water that extends over the surface



Tiger mosquito (*Aedes albopictus*) breeding space. Accumulations of stagnant water must be avoided



Sympetrum fonscolombii. Photo: Guillem Pascual



Water flea (*Daphnia* sp.)



Common stonewort (*Chara vulgaris*) forms meadows that provide shelter for many invertebrates

Naturalising ponds *to maintain the water's quality*



Great pond snail (*Lymnaea stagnalis*)

Description/application

The presence of zooplankton in a pond keeps its water transparent, as its direct filter-feeding reduces the aquatic system's bacterial load and phytoplankton. Water fleas (*Daphnia* sp.) are typical of such zooplankton and prove very useful in the management of naturalised ponds, as their filter action helps to maintain notable levels of transparency.

This transparency parameter has become a key factor in our urban context, one that should at least be taken into account, as it is often gives rise to complaints from the public. On the other hand, the presence of detritivore fauna (pond snails etc.,) helps to speed up the organic matter's decomposition process by avoiding problems of anoxia (lack of oxygen) associated with the water's increased murkiness caused by the rise of the pond's bacterial load.



Water flea (*Daphnia* sp.)

Surface re-circulation of water in naturalised ponds *to maintain the water column's stratification*



Tres Pins Plant Nursery's pond

Description/application

If a pond is to be kept clean and transparent it is important for the concentration of the nutrients dissolved in the water to be rather low, to prevent population explosions among the algae. This can be achieved to a large extent by ensuring the water column maintains its stratification and that the nutrients are confined to the pond's sediment and beyond the algae's range (they need light for photosynthesising and therefore live on the surface). Any water re-circulating and filtering system that stirs up the bottom of the pond and causes the water column's homogenisation will lead to eutrophic conditions that will upset the pond's natural balance.

→ It is therefore useful to promote a surface re-circulation in such naturalised ponds which maintains the water's stratification while enabling the exchange of gases and preventing the presence of stagnant water.

→ Where the naturalised ponds or ornamental fountains are provided with re-circulation systems, their pumps must be sized according to their respective container capacities, to prevent internal re-circulating and, in any case, the water propulsion from affecting the bottom of the pond.

Improving environments *to increase a habitat's biomass and suitability*



Plantation of genus *Fritillaria* bulbs. Jardins de Mossèn Cinto Verdaguer

Description/application

→ Shelter and feeding areas need to be made or preserved by putting up rockeries, walls or other elements such as piles of trunks, plant pots and tiles, and by planting rhizomatous species such as the African lily (*Agapanthus africanus*) and the bearded iris (*Iris germànica*), which offer amphibians numerous possibilities for hiding and resting. Shrubby plants that provide a certain amount of cover can also be used for this purpose.

→ The environment's litterfall needs to be maintained as much as possible. It offers a source of organic matter that will end up decomposed as humus, so closing the cycle of mineral elements. It also enables the development of a whole community of invertebrates sharing this decomposition and constituting, in its own right, a food resource for amphibians and other groups of fauna.



Lily plantation around the Tres Pins Plant Nursery's ponds

Pruning the environment's vegetation in several stages *to maintain the fauna's shelter areas*



Tres Pins Plant Nursery

Description/application

→ Where there is a need for pruning the environment's plants, this must be planned in several distinct stages so fauna can be offered shelter at all times. This means preserving non-intervention areas with a sufficient mass of plants to ensure amphibians and other groups of fauna can shelter there. When a pruned area has finally reached an important stage of development and therefore provides a suitable cover, the area used as a shelter up to that point will then be pruned.

Encouraging useful flora and fauna as a means to preserving biodiversity



Iberian waterfrog (*Pelophylax perezi*)

Common midwife toad (*Alytes obstetricans*) carrying eggs. Photo: Guillem Pascual



Muskgrass (*Chara sp.*)



Description/application

→ Care needs to be taken of the following species:

- Common midwife toad (*Alytes obstetricans almogavarii*). A small nocturnal toad. Its tadpoles can be observed in ponds throughout the year. A protected species under Generalitat of Catalonia's Legislative Decree 2/2008 on Animal Protection.
- Mediterranean tree frog (*Hyla meridionalis*). A frog that lives in the pond's surrounding vegetation and which is therefore very sensitive to changes to vegetation (extreme pruning). Its tadpoles can only be observed during breeding season. A protected species under Generalitat of Catalonia's Legislative Decree 2/2008 on Animal Protection.
- Iberian waterfrog (*Pelophylax perezi*). A frog that lives in the pond throughout the year. Its tadpoles can be observed throughout the year.
- Common stonewort (*Chara sp.*). Native fresh-water green algae, typical of lentic and low-nutrient water milieus, belonging to the Characeae family. It plays a very useful ecological role. It grows rather slowly but in stable conditions it can displace filamentous algae.

(See annexe 2: Useful fauna in Barcelona's fountains and ponds).

Mediterranean tree frog (*Hyla meridionalis*). Photo: Guillem Pascual



Introducing aquatic plants *to create biotopes for the fauna*



Tres Pins Plant Nursery's pond

Description/application

→ Aquatic plants should be put in naturalised ponds. Besides their aesthetic value, these plants play ecological roles of the first order and are of vital importance in achieving the aquatic system's natural balance:

- They capture the water's nutrients for their metabolism, thereby depriving unicellular and filamentous algae of these nutrients.
- They oxygenate the water through their photosynthesising, by raising the concentrations of oxygen dissolved in the water.
- They create biotopes for the pond's invertebrates and amphibians.
- The flowers of some aquatic plant species attract pollinating insects.



Bosc de Montjuïc School's pond

→ When aquatic plant pots or flower boxes have to be prepared, it is important not to use organic fertilisers or at least reduce their use as much as possible. Excessive fertiliser can lead to eutrophy and encourage the development of filamentous algae. For the same reasons, compost and other topsoils must not be used either as plantation. Materials such as gravel and grit will have to be used for that purpose.

→ Aquatic plants should be divided between January and February, if appropriate.

→ During its building process, a pond should have an allocated area for receiving sunshine at least part of the day so that its aquatic plants can photosynthesise. It is true, however, that too much exposure to the sun leads to a rise in the water's temperature and an acceleration of all the biological processes taking place there, making it more difficult to manage and maintain.

→ Some aquatic plant species were traditionally used due to their purifying capacities. No account has been taken, however, of the fact that some of these are exotic plants with a highly invasive behaviour that causes serious damage to natural systems. It is therefore better not to use species such as *Azolla filiculoides*, *Elodea canariensis* or water hyacinth (*Eichhornia crassipes*), all being exotic and invasive, but rather to use an extensive variety of the environment's native species. (**See annex 1: Aquatic plants at the Tres Pins Plant Nursery**).

All these exotic species are listed in Spain's catalogue of invasive exotic species because of their invasive potential and because they represent a threat to our local flora.



Parc del Laberint d'Horta's pond



Azolla filiculoides. Photo: Wikimedia



Elodea canadensis. Photo: Wikimedia



Water hyacinth (*Eichhornia crassipes*). Originally from South America, it is frequently used for its tissue's capacity to retain heavy metals. Photo: Wikimedia

Managing the fauna's access to ponds *so amphibians can get out of them*

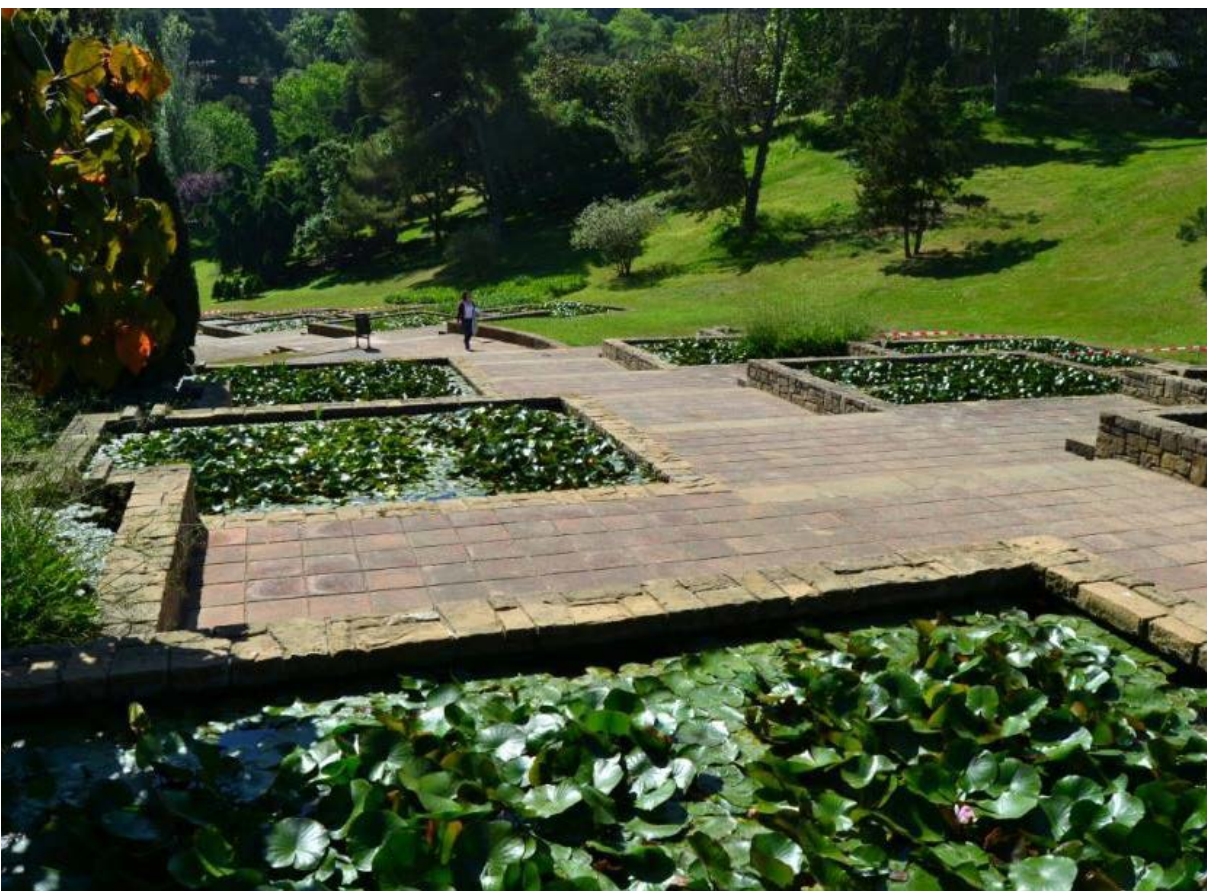


Angel Fountain. Pedralbes monastery

Description/application

➔ Natural or artificial access points to ponds have to be put up so the amphibians can use them and complete their biological cycle. These structures will also enable the animals to leave ponds they have accidentally fallen into.

Managing the public's access to ponds *to find a balance between public use and natural development*



Jardins de Mossèn Cinto Verdaguer's ponds

Description/application

➔ Passage ways need to be adapted so the public can enjoy ponds in a way that is compatible with the habitat's preservation (in ponds whose size, for example, makes this possible).

Public information for raising awareness of the value of these habitats and encouraging people's contact with nature



Description/application

→ Signage should be put up which conveys the habitat's values as well as the concept of naturalisation and the positive effects it entails.



AQUATIC PLANTS AT THE TRES PINS PLANT NURSERY

MUSKGRASS (*Chara sp.*)



Description: this is a native green alga some 50 cm long which is notable for its leaves which grow from nodes on its stem and present a very characteristic whorled arrangement. Strictly speaking, algae have no roots, stems or leaves but do have similar structures, known as rhizoids, cauloids and phylloids respectively.

Distribution: multi-regional.

Habitat: Stagnant, calcareous freshwater.

Planting: care should be taken to avoid removing all the pond’s sedimentary materials, to enable the algae to take root.

Ecological value: it grows in clear water that is poor in nutrients (oligotrophic) and is therefore associated with good-quality water. It is accordingly a bio-indicator species. It forms extensive under-water carpets that shelter numerous organisms, all necessary for balancing the aquatic ecosystem. It also contributes to the water’s purification, as it has an outstanding capacity for capturing nutrients, keeping the water transparent and even limiting the presence of mosquitoes in the pond, given that it releases larvicidal substances.

PENDULOUS SEDGE (*Carex pendula*)



Description: Presents long, deep-green, ribbon-like leaves. It develops large tufts that are often over a meter high (60-150 cm). Blossoming in the spring, its flowers are grouped in spikes of great ornamental value which can be maintained in the plant up to October. These spikes, ranging from 10 cm to 15 cm in length, grow erect but immediately start to bend as they develop.

Distribution: Eurosiberian region.

Habitat: riverine woodlands, river banks and pools. Semi-shaded.

Planting: in the spring, at a depth of between 0 cm and 10 cm under the surface of the water. Resistant to temperatures down to -20 °C. Easy to plant and grows fast. It is not invasive.

Ecological value: Capturing nutrients (including heavy metals) and it is therefore recommended for water-purifying treatments. Presents a negative allelopathy, in inhibiting the growth of algae by exuding chemical substances through its roots. Creates biotopes for amphibians and invertebrates.

SIMPLESTEM BUR-REED (*Sparganium erectum*)



Description: Presents long and ribbon-like leaves that can reach a height of 100-150 cm. Blossoms between June and August. White and perfumed flowers. Its fruit is formed in glomerules.

Distribution: multi-regional.

Habitat: slow-water and shallow pools. Sunny or semi-shaded exposure.

Planting: at a depth of between 20cm and 60 cm under the surface of the water. Resistant to severe frost. Invasive. Suitable for planting in sediments.

Ecological value: Uncontaminated-water indicator Capturing nutrients. Creates biotopes for amphibians and invertebrates.

HARD RUSH (*Juncus inflexus*)



Description: a perennial plant with cylindrical stems that can reach a height of 40-120 cm. Blossoms between May and August.

Distribution: multi-regional.

Habitat: bulrushes and humid areas with slightly acidic water. Lives in both shaded and sunny environments.

Planting: at a depth of between 2 cm and 10 cm under the surface of the water. It is advisable to plant it in high densities for greater aesthetic value and a shaded area. It tolerates low temperatures. It is invasive. It can be planted in sediments and in gardens.

Ecological value: Water purifying by capturing nutrients. Creates biotopes for amphibians and invertebrates.

GARDEN LOOSESTRIFE (*Lysimachia vulgaris*)



Description: this is a perennial plant that presents ramified stems that are quadrangular in section. Its leaves are sessile and large. It reaches heights of between 50 cm and 150 cm. It blooms between June and August and its flowers are grouped into yellow inflorescences.

Distribution: Eurosiberian region.

Habitat: reedbeds and grasslands on flooded or very humid soil. Sunny exposure though it also accepts semi-shaded exposure.

Planting: at a depth of between 0 cm and 6 cm under the surface of the water. It resists severe frost. It is not invasive. It can be planted in sediments and in gardens.

Ecological value: Capturing nutrients. Creates biotopes for amphibians and invertebrates. Its flowers attract bees and butterflies.

YELLOW IRIS (*Iris pseudacorus*)



Description: presents ribbon-like whitish-green leaves which reach heights of between 50 cm and 120 cm. Blossoms between May and July. Abundant and strikingly yellow flowers.

Distribution: multi-regional.

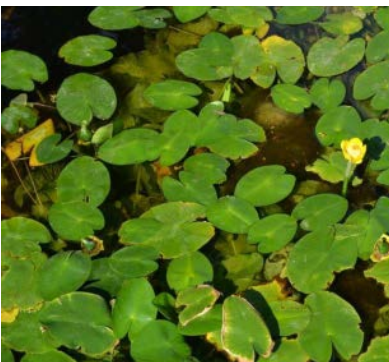
Habitat: bulrushes, marshes and shores. Sunny exposure though it also accepts semi-shaded exposure.

Planting: at a depth of between 4 cm and 10 cm under the surface of the water. It reproduces vegetatively through its rhizomes. It

is a fast grower. It resists severe frosts. It is not invasive. It is suitable for planting in sediments or aquatic gardens.

Ecological value: Capturing nutrients. It is used for purifying water as it absorbs heavy metals. It can live in water with have concentrations of nutrients (eutrophic). Creates biotopes for amphibians and invertebrates. Its flowers attract bees.

YELLOW WATER-LILY (*Nuphar lutea*)



Description: floating aquatic, perennial plant, with rhizomatous roots and flat, oval leaves, though smaller and pricklier than those of European white water-lilies. The incisures of its leaves are less deep than they are in white water-lilies. It blossoms from June to September. Its flowers are yellow and 6 cm in diameter.

Distribution: Eurasia.

Habitat: Lakes and fresh-water ponds. Lives in both sunny and semi-shaded areas.

Planting: in spring, to a depth of between 60 cm and 100 cm. Surface cover. It is advisable to plant it in spacious containers and periodically divide it. It can also reproduce from seeds. It tolerates temperatures down to -1 °C.

Ecological value: It is not affected by water-lily aphids. It is a native water-lily. Creates biotopes for amphibians and invertebrates. Its flowers attract insects.

WHITE WATER-LILY (*Nymphaea alba*)



Description: floating aquatic, perennial plant, with rhizomatous roots that present circular floating leaves that are dark green above and reddish underneath, between 10cm and 30 cm in diameter, with a deep, narrow incisure. It reaches heights of between 5 cm and 10 cm. It blossoms from July to September. Very large, white, fragrant, floating pedunculated flowers, between 10 cm and 20 cm.

Distribution: multi-regional.

Habitat: ponds and calm water. Prefers sunny environments, although accepts semi-shaded environments too.

Planting: at a depth of between 50 cm and 120 cm under the surface of the water. Surface cover. Does not tolerate temperatures below 5 °C. Its bulbs divide in the autumn. It is suitable to plant both in sediments and in aquatic gardens.

Ecological value: Capturing nutrients. Creates biotopes for amphibians and invertebrates. The shading it creates limits the appearance of algae. Its flowers attract bees.

UMBRELLA SEDGE (*Cyperus alternifolius*)



Description: perennial plant that normally reaches heights of between 40 cm and 120 cm. It has umbrella-shaped leaves at the end of its stems. It blossoms from May to September. Its yellowish-white flowers are of little visual interest and are grouped in bunches.

Distribution: Introduced. Originally from Madagascar.

Habitat: nearby river banks and water courses. Sunny or semi-shaded exposure.

Planting: at a depth of between 0 cm and 10 cm under the surface of the water. It does not tolerate temperatures below 5 °C. It can be pruned every two years, at the end of winter. It is not invasive. It associates well with water-lilies and pickerel weeds. It is suitable to plant both in sediments and in aquatic gardens.

Ecological value: Capturing nutrients. Creates biotopes for amphibians and invertebrates.

PICKEREL WEED (*Pontaderia cordata*)



Description: perennial plant with shiny dark-green, narrow, lanceolate leaves. It reaches heights of between 60 cm and 130 cm. It blossoms from June to September. Its flowers are grouped in lilac-blue spikes.

Distribution: multi-regional.

Habitat: ponds and lakes, in full sunshine.

Planting: at a depth of between 15 cm and 30 cm under the surface of the water. Resistant to severe hard rime. It is not invasive. It is a fast grower. It is generally planted in plant pots.

Ecological value: Capturing nutrients. Creates biotopes for amphibians. It is excellent for attracting and breeding dragonflies. Its flowers attract butterflies, bees and other invertebrates.

FEN PONDWEED (*Potamogeton coloratus*)



Description: Perennial, rhizomatous plant with floating, oval and reddish-green leaves, between 5 cm and 10 cm long. It reaches heights of between 10 cm and 50 cm. It blossoms from August to October.

Distribution: multi-regional.

Habitat: slow-running, shallow small pools and brooks. Prefers water that is rich in calcium but poor in nutrients. Moderate sunshine.

Planting: at a depth of between 20 cm and 60 cm under the surface of the water.

Ecological value: Creates biotopes for amphibians and invertebrates.

PURPLE LOOSESTRIFE (*Lythrum salicaria*)



Description: perennial semi-aquatic plant with dark-green lanceolate leaves. It reaches heights of between 60 cm and 120 cm. It blossoms from May to September. Its flowers are grouped in purple clusters.

Distribution: multi-regional.

Habitat: grasslands on humid soil watered by rivers and brooks. Exposure to moderate sunshine.

Planting: at a depth of between 0 cm and 10 cm under the surface of the water. Reproduces by seeds or plant division in the spring. It resists severe frosts. It is not invasive. It is suitable to plant both in sediments and in aquatic gardens.

Ecological value: Its flowers attract bees and butterflies.

Curiosities: *Lythrum* comes from the Greek *lythron*, which means blood. This refers to the colour of the flowers and to the antihemorrhagic effects that some of this genus' species present. Hence its other names in Catalonia, “estroncasang” (blood-stemming). And, because of its astringent properties, it is also known as “estroncaculs” or “herba de les cagarrines” (anti-laxative herb).

POWDERY THALIA (*Thalia dealbata*)



Description: this is a perennial plant with oval leaves held up by long peduncles. It blossoms from June to August. Its flowers are violet and grouped together in spikes.

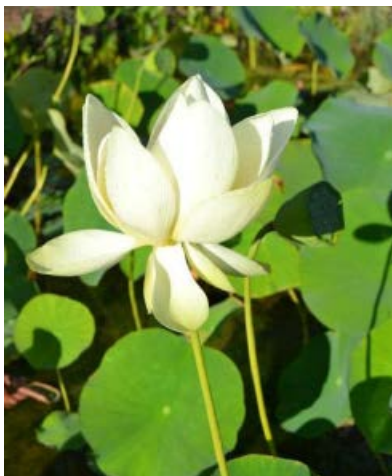
Distribution: multi-regional.

Habitat: it grows in humid or shallow-water soil in full sunshine.

Planting: at a depth of between 10 cm and 60 cm under the surface of the water. It reproduces by dividing its tubers in the spring. It resists severe frosts. It is not invasive. Suitable for planting both in sediments and in aquatic gardens.

Ecological value: Capturing nutrients. Creates biotopes for amphibians and invertebrates. Its flowers attract bees.

INDIAN LOTUS (*Nelumbo nucifera*)



Indian lotus (*Nelumbo nucifera*) flower and fruits

Description: aquatic rhizomatous plant with large, round bluey-green leaves. It reaches heights of between 60 cm and 90 cm. It blossoms from June to August. It has large, generally white or pink flowers. Its fruit, which is shaped like an inverted cone, is of aesthetic value.

Habitat: exposure to moderate sunshine.

Planting: needs a depth of at least 60 cm to grow. Planting in the spring. Reproduction by rhizomes in the spring-autumn and by seeds. If its seeds are to be sown they need to be scarified with sandpaper and soaked in water. They will germinate within a week and can be transplanted in large flower pots that their roots can grow in. It is advisable to remove dry leaves to prevent an excess of organic material from building up in the pond. It does not tolerate low temperatures and suffers from problems below 5 °C.

Ecological value: Capturing nutrients. Creates biotopes for amphibians and invertebrates. Its large leaves provide shade and therefore limit the growth of algae.

Curiosities: it is the national flower of India. It symbolises purity, beauty, majesty, fertility, abundance, wealth, wisdom and serenity. It has been the symbol of good fortune in Indian culture since antiquity.

USEFUL FAUNA IN BARCELONA'S
FOUNTAINS AND PONDS

INVERTEBRATES

WATER FLEA (*Daphnea* sp.)



Photo: Guillem Pascual

Description: water fleas are small filter-feeding crustaceans that belong to the Daphniidae family. They measure between 1 mm and 3 mm in length and are therefore visible to the human eye.

Ecology: they live in fresh water ponds, pools and lakes. They are popularly known as water fleas because of the way they move. They have a pair of antennae they use for flagellating, as a means of moving around through water columns. Water fleas have a lifespan of around two weeks.

Reproduction: they reproduce through parthenogenesis and in that respect they are very prolific animals. In optimal conditions a female can give birth to 10,000 million eggs in a period of 60 days. Its eggs can

travel on the feathers or feet of aquatic birds, such as ducks, and move to another pond.

Feeding: they are filter-feeding animals that live off single-cell algae, bacteria and microscopic organic remains. Its filtering action enables it to keep the pond's algae populations in check, thereby increasing the water's transparency.

WATER SNAILS (*Physella acuta*, *Lymnaea stagnalis*, *Radix peregra*, *Ancylus* sp., etc.)



Photo: Guillem Pascual

Ecology: these species of aquatic snails feed off detritus and therefore play a very important role in processing the organic matter (litterfall, small branches and food leftovers) of ponds. An excess of organic matter can cause an outbreak of anaerobic organisms which, in some cases, generate foul odours and toxins that harm the pond's biota. Such excesses of organic matter also make the water murky as a result of its increased bacterial load. It is important, then, to ensure populations of aquatic snails are well represented and conserved.

Reproduction: they breed from spring to the end of summer. They normally lay their eggs among aquatic plants or under their leaves.

Note: not all species of aquatic snails are detritivore; some feed on plant material (algae and aquatic plant leaves).

MIDGES (*Chironomus* sp.)



Photo: Guillem Pascual

Description: known as “mosquits d'eixam” (swarm mosquitoes) in Catalan due to the fact that, as adults, these midges form huge swarms around water. Their larvae vary in colour depending on the species; some, given their red-coloured body, are also popularly known as “mosquits vermells” (red mosquitoes). This colour is due to the presence of a respiratory pigment, haemoglobin, which enables them to capture oxygen in the water where

it is found in low concentrations.

Ecology: larvae live in the sediment of the pond and feed off the remains of organic matter. Chironomids in water act as a bioindicator of its quality. Their presence is in response to low concentrations of oxygen normally associated with stagnant water with a high level of organic matter and therefore poor in quality. Unlike their common mosquito female counterparts, they do not bite, as they do not feed on blood; in fact, many of these species do not feed during their adult stage, which they reach for reproductive purposes.

MAYFLY (*Cleon sp.*)



Description: these are notable for their larvae with three very long tails at the end of their abdomen and gills at the side of their abdomen which allow them to breathe under water. Adults also have two long tails and fins with very pronounced nerves that fold backwards.

Ecology: their name refers to their short lifespan as winged adults (a single day). In fact, when adults, they have no mouth and therefore cannot feed, using their short life for reproduction. Their larvae are aquatic and move around the bottom and walls of ponds, feeding on organic remains. They are important in the decomposition cycle of organic matter.

BACKSWIMMERS (*Notonecta maculata, etc.*)

Description: these swim on their backs on the surface of the water, helped along by their hind legs, which are longer than their others and are used as oars. Their middle legs are used for grabbing hold of underwater vegetation and, together with their forelegs, for capturing prey. They have functional wings beneath their protective wings which enable them to fly and move to new ponds when their present ones dry up.

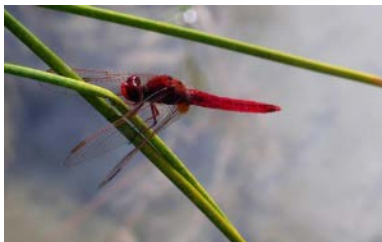


Ecology: backswimmers live in ponds, pools and anywhere that accumulates stagnant water. They have a stinging-sucking mouth piece they use for feeding on small invertebrates, such as mosquito and fly larvae as well as vertebrates such as small tadpoles and fry. Their predatory condition gives them an important role in the food chain, as they regulate both invertebrate and vertebrate populations and therefore contribute towards the pond's equilibrium.

DRAGONFLIES AND DAMSELFLIES (*Anax imperator, Sympetrum striolatum, Ischnura graellsii*)



Anax imperator. Photo: Guillem Pascual



Dragonfly Crocotthemis erythraea. Another regular visitor to ponds. Photo: Guillem Pascual



Dragonfly exoskeleton

Description: damselflies are noted for their slim, elongated body and well-separated eyes. By contrast, dragonflies have a stouter body and closely set eyes. Nevertheless, the distinctive feature that best allows damselflies to be distinguished from dragonflies is that the former fold their wings backwards when resting while the latter keep theirs open.

Ecology: they have a short lifespan (several weeks) which they make the most of to reproduce. Females lay their eggs in the water which the larvae hatch from to feed on aquatic invertebrates, small tadpoles and fry, all of which they capture using a strong, foldable mandible. Note here the large predatory capacity of these larvae. After numerous moults, the larvae become nymphs which finally emerge from the water, climbing up the stem of an aquatic plant and breaking their exuviae (exoskeleton) to enter their adult stage. A full cycle can last up to two years, depending on the species. Adult dragonflies and damselflies feed on a large variety of flying insects, such as mosquitoes.

AMPHIBIANS

COMMON MIDWIFE TOAD (*Alytes obstetricans*)



Description: this is a small toad, some 5 cm long, brown in colour and with granulated skin and small tubercles. It has vertical pupils and golden irises with black spots and rounded muzzle with two visible nasal orifices. Tadpoles from this species are large and robust, with a rounded muzzle too, and usually move around the bottom of ponds.



Common midwife toad. Note its vertical pupils, golden irises and nasal orifices

Ecology: nocturnal, lives among litterfall, rocks and rhizomatous plants near to ponds.

Unlike other amphibian species, it lays its eggs outside the water, so once the female has finished laying its eggs, a male will then fertilise them and wrap them around its extremities, transporting them for roughly three weeks, which is the time necessary for tadpoles to hatch. Males then look for water points such as ponds, pools, fountains and brooks for releasing the tadpoles so they can continue developing. Males can carry eggs from several females and each laying episode can contain between 20 and 60 eggs.

Reproduction: males attract females at the start of spring through a very characteristic call reminiscent of the call of a small summer insectivore: the Eurasian scops owl (*Otus scops*). They can be heard croaking during humid spring nights. In any case, they present two breeding seasons, the most important being in the spring and the other in the autumn. That means tadpoles can be seen in ponds throughout the year, as some of those hatched in the autumn move into the water in the winter (metamorphosing tadpoles) thereby completing their metamorphosis in the following year.

Feeding: adults feed on worms, spiders, snails, slugs and other invertebrates. Tadpoles, by contrast, are detritivores and feed off decomposing organic matter, although their diet also includes mosquito larvae.

Location: Barcelona has historical populations in the ponds at the Tres Pins Plant Nursery, the Jardins del Laberint d’Horta, in the old Botanical Gardens, at the Teatre Grec and the Jardins de Laribal, among other places.

MEDITERRANEAN TREE FROG (*Hyla meridionalis*)



Photo: Guillem Pascual



Photo: Guillem Pascual



A pair of amplexus tree frogs . Note the difference in size: the larger female below and smaller male above. Photo: Guillem Pascual

Description: this is a small, smooth-skinned frog, some 5 cm long, notable for its bright green colour and a black stripe across its face. In fact, it is this stripe which allows it to be told apart from the tree frog from the same genus which is also present on the Iberian peninsula: the European tree frog (*Hyla arborea*); in the latter’s case, the black stripe runs along its sides to reach its back extremities. It has a whitish ventral area and horizontal pupils. Tadpoles from this species are small and delicate. It is not ed for its disproportionately large and prominent eyes. It moves along the bottom through the water column.

Ecology: adult tree frogs are normally found in dense vegetation nearby the ponds they use for sunbathing during the spring and summer. It is a climber by nature. During the winter, however, it usually shelters between litterfall and trunks, where it remains inactive.

Males are territorial and therefore compete with one another to find a place in the pond and attract females through their croaking.

This species only uses ponds for breeding.

Reproduction: it breeds from the spring to the end of the summer. After mating, females lay their eggs in the pond’s under water vegetation. It is at this point that the tadpoles complete their metamorphosing, so that the first juvenile frogs can be seen outside the pond as from August.

Feeding: adults feed on small invertebrates, such as mosquitoes, small cockroaches, ants and flies. Tadpoles feed on algae and aquatic plants.

Location: in Barcelona they breed in the artificial pools in the Jardí d’Aclimatació de Montjuïc, the gardens of the Palau Reial, the Tres Pins Plant Nursery, the Jardins de Mossèn Cinto Verdaguer and the Laberint d’Horta, to name a few places.

IBERIAN WATERFROG (*Pelophylax perezi*)



Description: this is a frog that comes in many varieties of colour that can range from green to brown or grey with dark spots. It has a whitish, spotted ventral part. It presents sexual dimorphism in its sizes: females can measure as long as 11 cm, whereas males are a bit smaller and are usually roughly 8 cm. It has horizontal pupils and golden irises. Its tadpoles are large and robust with a pricklier muzzle than those of common midwife toads and without visible nasal orifices. It mainly moves around the bottom and walls of ponds.

Ecology: Iberian waterfrogs live in water throughout the year, though they can make sporadic incursions onto land in search of food and new ponds. It is the most aquatic of the three species, to the point where it normally spends the winter in the pond buried in the sediment.

Reproduction: it breeds late, as it starts at the end of the spring and continues up to the end of the summer. It lays its eggs in aquatic vegetation. Its tadpoles can spend the winter in ponds, just like common midwife toads and can therefore be found in ponds throughout the year.

Feeding: it feeds on a large variety of both land and aquatic invertebrates as well as small vertebrates, including metamorphosing tadpoles from the same or other species. Its tadpoles feed on detritus and plant material.

Location: Barcelona has historical populations in the Jardins de Mossèn Cinto Verdaguer, the Tres Pins Plant Nursery, Turó Park and the Laberint d’Horta, among other places.

TADPOLE-IDENTIFICATION GUIDE



COMMON MIDWIFE TOAD TADPOLE	
Distinctive traits	
Size	Up to 90 mm
Position of eyes	Dorsal and closely set eyes
Position of spiracle	In the middle of the stomach (closer to the mouth than the anus)
Position of anus	In the ventral area in the central position
Tail	With dark spots
Muzzle	Rounded
Behaviour	It moves around the bottom and walls of ponds.



TREE FROG TADPOLE	
Distinctive traits	
Size	Up to 40 mm
Position of eyes	Prominent lateral eyes
Position of spiracle	In the middle of the stomach (closer to the mouth than the anus)
Position of anus	In the ventral area to the right and close to the head
Tail	Presents a caudal ridge that appears behind the eye, very high and convex above and below and which ends in a sharp point
Muzzle	Rounded
Behaviour	It moves along the pond’s water column



IBERIAN WATERFROG TADPOLE	
Distinctive traits	
Size	Up to 110 mm
Position of eyes	Dorsal and separated eyes
Position of spiracle	In the lateral left area of the head
Position of anus	In the ventral area on the right
Tail	Presents a caudal ridge with dark and large spots. A longitudinal central dark line can be observed along its tail
Muzzle	Prickly
Behaviour	It moves along the pond’s water column

Source: Catalan tadpole identification guide.
www.gno.cat/media/ambits/guiacapgrossos2.pdf

LIST OF GARDENS WITH NATURALISED PONDS
IN BARCELONA AND THEIR ASSOCIATED FAUNA

GARDEN	ASSOCIATED FAUNA
Jardins de Mossèn Cinto Verdaguer	Iberian waterfrog, tree frog, dragonflies and other aquatic invertebrates
Jardí d'Aclimatació	Tree frog, Iberian waterfrog and aquatic invertebrates
Jardins del Teatre Grec	Common midwife toad and aquatic invertebrates
Jardins de Laribal	Common midwife toad, tree frog and aquatic invertebrates, including planarians (<i>Schmidtea mediterranea</i>)
Turó Park	Iberian waterfrog, common midwife toad and other aquatic invertebrates
Jardins del Palau de Pedralbes	Tree frog, Iberian waterfrog, common midwife toad and aquatic invertebrates
Jardins de la Tamarita	Common midwife toad, tree frog and aquatic invertebrates
Jardins del Laberint d'Horta	Common midwife toad, tree frog, Iberian waterfrog, Spanish toothcarp, viperine water snakes and aquatic invertebrates
Tres Pins Plant Nursery	Common midwife toad, Iberian waterfrog and aquatic invertebrates
Can Cadena pond	Iberian waterfrog and aquatic invertebrates



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Cliffs are rocky formations with a steep slope – sometimes completely vertical – that are found not just at points of contact between land and sea but on mountains. These formations are interesting for their geological and landscape aspects and for the presence of rupicolous flora and fauna (living among rocks). Cliffs are scarce along the Catalan coastal depression, although Barcelona itself has three notable cliffs: the Morrot cliff, on the south-east-facing slope of Montjuïc and next to the commercial port and, more inland, the Parc de la Creueta del Coll cliff and the Tres Turons cliff.

Rock-quarrying activities over many centuries ended up forming rupicolous habitats playing similar roles to natural cliffs and which today enrich the city's ornithological biodiversity with species scarcely found in cities, such as blue rock thrushes, owls, kestrels and peregrine falcons (Morrot). The latter space presents a large ornithological variety that is complemented with reptiles and small mammals. It is worth noting that Morrot's kestrels formed a nesting colony, despite the fact the species does not usually exhibit such gregarious behaviour.

It is therefore a place with great potential as a point of attraction for bird watchers.



Walls

Stone and other walls, as artificial formations, can host several plant species and help to encourage the presence of invertebrates, reptiles, birds and small mammals. There are a very large number of stone walls and some, especially in parks and more recent sites, take the form of gabion walls, in other words, containers of stones held together with a wire mesh. Given the history and layout of the city, hundreds of smooth walls (without holes or cracks) can also be found. The life forms associated with stone walls depends on the environment in which it is situated, orientation, geological substrate and height. Animals find shelter in them and a place for rearing, feeding and hibernating. Cracks and holes need to be preserved if biodiversity is to be maintained, a simpler goal in stone walls than in smooth ones. In the latter case, fauna can take advantage of elements such as ventilation holes for the same purpose.

Party walls also offer opportunities for biodiversity that can be used for example, for putting up integrated artificial nests or plants. In fact, some of them are either completely or partially covered with plants that encourage the presence of fauna. A distinction should be made, however, between party walls that may be temporary, owing to the construction of new buildings, and those that have become permanent. In any case, the initiatives that can be embarked on in these spaces are full of nuances that have to be assessed on a case-by-case basis.

Wall inventories and cliff-management plans are two major tasks that should make a big contribution to the goals described.

Conserving cliffs *to protect against their deterioration*



Montjuïc's cliffs

Description/application

It is important to appreciate these natural sites, as they constitute a rare rupicolous habitat in an urban context and play a very notable ecological role. They host a series of plant and animal communities typical of these environments which need to be conserved and promoted as points of special interest for enriching biodiversity.

→ Periodic cleaning has to be carried out to prevent the build-up of rubbish that may harm the natural heritage or cause fires.

Managing plants on walls *to boost their biodiversity*



Parc de les Aigües' gabion walls

Description/application

The various possibilities for action in the vegetation's maintenance need to be studied according to each wall's features and associated biodiversity.

Several options are being considered:

→ Not "vegetating" stone or other walls where they already exhibit biodiversity. Established house sparrow (*Passer domesticus*) colonies or great tit (*Parus major*) nests, for example, are grounds for ruling out any landscaping and for preventing undesirable predators, such as rats, from gaining access.

→ If the wall already has climbing plants and is used for nesting or sheltering birds, pruning work will have to be done (outside the birds' nesting period) so these plants can be contained.

→ Where plants have to be removed for ornamental purposes, cleaning should be done preferably during the winter period, thereby avoiding, if further action is required, the birds' nesting period.

A preliminary assessment must therefore be made to ensure maintenance work is not carried out to the detriment of biodiversity.



Tres Pins Plant Nursery. Montjuïc

Preserving cavities/gaps in walls *to encourage several species to find shelter and nesting places there*



House sparrow (*Passer domesticus*) nest

Description/application

Holes should not be obstructed or cracks filled in if these spaces are to allow the presence of fauna. It is advisable, where possible, in the case of newly built stone walls, to use dry stone, as it offers great durability and environmental benefits, such as halting the soil's erosive processes and creating habitats for numerous animal and plant species. (**See *annexe 1: Stone walls***). In any case, the use of cement and concrete should be avoided for covering over cracks or holes or at least to consciously leave them without filling them in.



Tres Pins Plant Nursery



Parc de Joan Raventós

Preparing inventories and monitoring walls *for designing biodiversity-promoting initiatives*



Stone walls. Pedralbes' allotments

Description/application

Key factors must be taken into account, such as orientation, geological substrate or height where the holes etc., are located, such as degree of sun exposure, which is very important for reptiles. The inventory should also include the species most frequently found in the area that can use the space studied as a habitat. It is therefore a question of knowing the features of the city's walls so pro-diversity initiatives can be designed and monitored. Such work is intended to help establish the general guidelines the specific initiatives will fall under and whose results will subsequently be checked.



Mas Ravetllat's stone walls



Passeig de Turull

Boosting the presence of plants on walls of little use to fauna to ensure a suitable degree of vegetation and promote biodiversity



Wall vegetated with lesser bougainvillea (*Bougainvillea glabra*) Parc del Centre del Poble Nou

Description/application

Walls without holes or cracks should be vegetated, to make them more attractive to fauna, by offering them opportunities for feeding, sheltering and nesting. In some cases it would be advisable not to cover the entire walls but to leave areas exposed to enable the presence of desired predators, such as common wall geckos (*Tarentola mauritanica*), whose hunting territories lie in these plant-free areas.



Common wall gecko (*Tarentola mauritanica*) with regenerated tail

Climbing plant species which interact with local fauna need to be selected. Examples:

→ Common ivy (*Hedera helix*) is a good choice as it develops a large density of foliage, so providing nesting and sheltering places for species such as Eurasian blackcaps (*Sylvia atricapilla*), white wagtails (*Motacilla alba*) and common blackbirds (*Turdus merula*). What is more, it blossoms in the autumn (which is beneficial for bees, wasps, hoverflies and butterflies) and fruits in the winter, providing food for birds such as the above-mentioned blackcaps, blackbirds, Sardinian warblers (*Sylvia melanocephala*), European robins (*Erithacus rubecula*) and black redstarts (*Phoenicurus ochruros*), during a time of the year when food resources are scarce. It also ensures a constant presence of insects and invertebrates, which are the basis of the food chain and therefore increase the complexity of the food relationships of the various groups of fauna.

→ Other native plants that are useful for their fruit and/or flowers include: caper bushes (*Capparis spinosa*), Minorca honeysuckle (*Lonicera implexa*), common hop (*Humulus lupulus*), Old man's beard (*Clematis vitalba*), fragrant virgin's bower (*Clematis flammula*), elm-leaf blackberry (*Rubus ulmifolius*), dog-rose (*Rosa canina*), evergreen rose (*Rosa sempervirens*), common grape vine (*Vitis vinifera*) and rough bindweed (*Smilax aspera*).

→ It is also advisable to use alien climbing plant species such as Chinese wisteria (*Wisteria sinensis*), the Australian "native" wisteria (*Hardenbergia comptoniana*), Chinese star jessamine (*Trachelospermum jasminoides*) and the passionflower (*Passiflora caerulea*), all of which have flowers that attract pollinating insects.



Common ivy (*Hedera helix*)



Rough bindweed (*Smilax aspera*)

Adapting the sizes of holes in walls to influence the presence of certain species



House sparrow (*Passer domesticus*)

Description/application

Biodiversity needs to be boosted by limiting the presence of excessively abundant species and offering opportunities for rarer species. For this reason it is useful for holes and cracks to come in different sizes. Hole sizes determine the type of fauna that can access them:

→ Rock pigeon (*Columba livia*): pigeons can enter round holes with diameters of at least 8 cm (and rectangular holes measuring 5 cm x 14 cm). If we bear in mind the large population of pigeons found in Barcelona (around 85,000, according to the Barcelona Public Health Agency data from 2015), it would be useful to keep down the number of holes of this size to provide more options for rarer species. In this regard, we can opt to reduce sizes of entry holes by putting metal railings over them and preventing their access. Restricting the number of rest and breeding places available to them using deterrent elements and limiting the number of feeding spaces are other measures that can be put in place, besides culling (where the population densities of this species reach levels posing a risk to public health).

→ Western jackdaws (*Corvus monedula*): are small ravens present in Barcelona which use holes and the chambers provided by buildings in the old quarter and Eixample to build their nests in. The main problem for their conservation is that they use holes with similar sizes to pigeon holes. It must therefore be borne in mind that the option of covering up holes in places with existing populations can have negative effects on this species, whose numbers are falling.

Hole sizes in buildings and environments that jackdaws nest in can be reduced to 7 cm diameters (or to 6 cm x 12 cm where the holes are rectangular), to make it hard for pigeons to access.



Rock pigeon (*Columba livia*)



Adapting holes for jackdaws. Fàbrica del Sol



Western jackdaw (*Corvus monedula*)

Adapting holes to several wall heights *to promote the diversity of species*

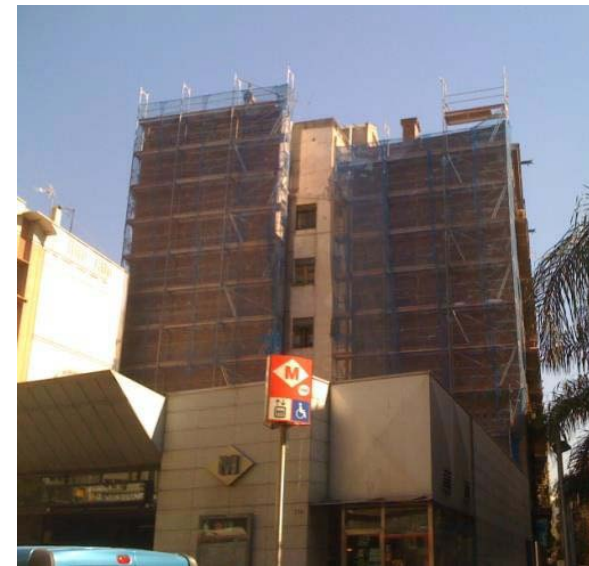


House sparrow (*Passer domesticus*) nesting colony

Description/application

→ Holes need to be located at various heights to offer feeding, sheltering and rearing opportunities to several groups of fauna. Whereas amphibians, reptiles and some micromammals use holes on the lower parts of walls, other animals, such as birds, avoid holes near the ground owing to the easy access they provide predators with. For some species, then, hole heights are a limiting factor which has to be borne in mind. So it is a good strategy for the wall to present holes at several heights to promote biodiversity.

Carrying out redevelopment work on buildings *during appropriate periods to avoid interfering in animals' biological cycles*



Redevelopment work on Carrer d'Astúries with adjustments to party-wall entrance holes for swifts. Photo: Sergi Garcia

Description/application

The fauna that is present must be known beforehand, through an inspection of the space in question.

Once it is known, action can be planned for what is reckoned to be the most appropriate time.

→ The period of action in buildings that have to be redeveloped should be between November and March, as most species associated with buildings (swifts and swallows) migrate in the autumn and return in the spring. If the nature of such work makes it impossible to finish within this period, the entrance holes will have to be closed, using nets or canvas, before the birds arrive, to prevent them from nesting in them and starting their breeding process (spring-summer). It should of course

be noted that authorisation is required from the Barcelona branch of the Catalan Ministry of Agriculture, Livestock, Fishing and Food of the Generalitat of Catalonia, if protected species (swifts, swallows and bats) are to be removed or prevented from accessing their nests.

→ Two important periods need to be borne in mind for bats (Chiroptera): the winter, during which bats group together in shelters that provide them with more or less constant temperatures; and the spring, during their breeding season in sunny, south-facing shelters. So any work that affects the hibernating colonies will have to be carried out in the spring or summer; whereas any work that affects the breeding will have to be performed over the winter.

Promoting the installation of artificial nests in buildings *to encourage the presence of fauna*



Roof tiles for swallow nesting

Description/application

Buildings provide support for urban biodiversity given that several species, attending to their biological needs, use them as escarpments or natural structures. Rural buildings offer places for breeding in holes and cracks. By contrast, newly constructed buildings are generally unsuitable for hosting fauna, for reasons of aesthetics and sustainability. Several types of action are evident then:

- Ordinary and tiled roofs can have ventilation tiles that can be fitted into them when they are being revamped, with an opening hole that gives fauna access to the interior.
- Closed-off rooms' ventilation holes can be left open when façades or party walls are being redeveloped. Where the holes are large we can reduce their sizes to prevent pigeons from entering them.

→ Putting up artificial nests integrated into newly constructed buildings and revamped party walls and façades.

(See *annexe 2: Fauna in buildings*.)



Common house martin nests. Correus building. Photo: Sergi Garcia



Common swift (*Apus apus*) nest on Carrer Pavia. Photo: Sergi Garcia

Preparing management plans for cliffs *for preserving and boosting their biodiversity*



Caspian gull (*Larus cachinnans*) on Montjuïc's cliff

Description/application

→ Management plans will have to incorporate a series of general goals:

- Creating access-detering elements in certain parts of the cliffs to promote the conservation of fauna and flora and deal with safety issues.
- Establishing and sign-posting routes.
- Highlighting the natural values of sites with appropriate signage.
- Avoiding accumulations of rubbish, to prevent fires and the deterioration of the space.

→ Management plans will also have to take account of each cliff's specific characteristics and values:

El Morrot de Montjuïc

- Mixing field plants and Mediterranean brushwoods with naturalised exotic species and a large diversity of bird species with kestrels and owls and unusual species in urban contexts such as the blue rock thrush (*Monticola solitarius*).
- Geological interest: Montjuïc is listed in the Catalan catalogue of sites of geological interest.
- Landscape interest: views over the commercial port.



El Morrot de Montjuïc



Creueta del Coll's cliffs

Creueta del Coll's cliffs

- These present a plant and fauna community in an outstanding state of conservation in an urban context.
- Geological, social and landscape interest.
- Existence of a mass of water that encourages the presence of birds and bats (chiroptera).

Turó de la Rovira

- Geological, social and landscape interest.
- Two interesting biotopes: common thatching grass fields (Mediterranean dry fields) and rupicoline environments created by operating the quarry.
- Situation of alignment with Parc Güell and Parc del Guinardó (an axis that enables the fauna to disperse and move around).

STONE WALLS



Dry stone walls. Les Gunyoles. Barcelona Province

Stone walls have been used in the rural world by making the most of the material found from clearing stones from fields. Even so, the technique for building dry stone walls stopped being used, for mainly economic reasons, during the latter half of the 20th century. Note, however, the great cultural and landscape value dry stone walls have, seeing as they are part of our Mediterranean heritage and enjoy a series of ecological advantages that other types of walls do not offer:

- They halt the soil's erosion processes.
- They play a very important thermal role, as they dampen the effects of temperature.
- They keep cool during the summer's high temperatures and absorb heat during the winter.
- They stay humid inside.

Such features make dry stone walls an ideal habitat for many species of fauna and flora seeking shelter, breeding and nesting places, food and hibernation places. The wealth of an area's fauna is connected to the diversity of the milieus that the environment offers and, in this regard, dry stone walls help to increase this biodiversity.

Insects and other invertebrates

These are the group that shows the strongest relationship with stone walls, with a large number of invertebrates seeking shelter and breeding spaces in these structures. They are at the staple food that the other groups of fauna depend on and therefore occupy a key position in the food chain. They also play a vital role in controlling pests. Earthworms, centipedes, milipedes, scolopendromorpha, spiders, snails, cockroaches, grasshoppers are just a few of the invertebrates that can be found in association with stone walls.



Beetle (*Blaps lusitanica*)



Wasp spider (*Argiope bruennichi*)

Amphibians

The use of stone walls by amphibians is directly linked to the presence of aquatic milieus in their nearby environment. They use them as shelter and feeding spaces, so they occupy a place half-way along the food chain. They are preyed on by snakes and birds - as well as cats, when it comes to urban contexts - while preying themselves on small invertebrates. The main species in Barcelona that can use stone walls are as follows:



Common midwife toad (*Alytes obstetricans*)



Mediterranean tree frog (*Hyla meridionalis*).
Photo: Guillem Pascual

Reptiles

They use stone borders for sheltering, breeding and feeding as well as sunbathing (they are poikilothermic animals, that is, they have no mechanism for regulating their body temperature and therefore need to sunbathe to stay active). Geckos and lizards are the best adapted to this ecological niche, as they find ideal temperature and humidity conditions there. They occupy a halfway point along the food chain, as they are preyed on by snakes and small birds of prey, such as common kestrels, while preying themselves on insects.

The following are the most frequently found species here:



Common wall gecko (*Tarentola mauritanica*). Photo: Sergi Garcia



Male Columbrete wall lizard (*Podarcis liolepis*)



Mediterranean house gecko (*Hemidactylus turcicus*).
Photo: Sergi Garcia



Large psammodromus (*Psammodromus algirus*). Photo: Sergi Garcia

Although rarer, given the urban context, snakes should not be forgotten either, with stone walls providing them with spaces for resting and protection from predators, as well as feeding places for the high number of prey found in walls, such as micromammals and small birds. Note that snakes are protected species and may not be taken or disturbed. They are harmless species. Two species of snake found in the most wooded parts of the city are:



Montpellier snake (*Malpolon monspessulanus*). Photo: Guillem Pascual



Ladder snake (*Rhinechis scalaris*). Photo: Guillem Pascual

Birds

Being vertical, walls make access difficult for predators and offer some security when it comes to finding suitable nesting places.

Cats and rats are becoming their main threat in cities, as they feed not just directly on adults but on eggs and baby birds. Some birds rear in the holes and cracks of walls and many others use them as a watch tower, so their value for this group of fauna is very notable. Although they do not always use stone walls as nesting substrates, it is hardly surprising to find the following species nesting in them:

- House sparrow (*Passer domesticus*)
- Eurasian blue tit (*Cyanistes caeruleus*)
- Great tit (*Parus major*)
- Black redstart (*Phoenicurus ochruros*)
- European robin (*Erithacus rubecula*)
- Little owl (*Athene noctua*)



Black redstart. Photo: Wikimedia



Eurasian blue tit. Photo: Wikimedia



Little owl. Photo: Wikimedia

Mammals

Where the wall's environment presents a suitable level of plant development, such structures are frequently used by small mammals. They provide spaces for storing food, sheltering or breeding. Micromammals are natural prey for snakes, birds of prey and other mammals such as foxes and genets and therefore play an important role in the food chain. Wild cat colonies in the city are having an adverse affect on their populations. Likewise, insectivorous micromammals, such as shrews, prey on small insects and a whole range of invertebrates, whereas rodent micromammals (mice) play an important ecological role in disseminating seeds.

The main species associated with walls are:



Greater white-toothed shrew (*Crocidura russula*)



Wood mouse (*Apodemus sylvaticus*)



Western Mediterranean mouse (*Mus spretus*)



Black rat (*Rattus rattus*)



Brown rat (*Rattus norvegicus*)

Lichens

Lichens are grouped under several categories, depending on the nature of the substrate they colonise. One of them is *lichens saxicola*, which grows on rocks and can be found associated with stone walls, where the levels of the environment's pollution so permit. It is worth highlighting their role here as bio-indicators. Some of the lichens we can find on rocks are:

- *Xanthoria parietina*
- *Caloplaca flavocitrina*
- *Verrucaria macrostoma*



Steps at Laberint d'Horta



Xanthoria parietina

Ferns and mosses

Dry stone walls situated in humid places often host mosses and small ferns. Some fern species associated with walls are:

- Southern maidenhair fern (*Adiantum capillus-veneris*)
- Rustyback (*Ceterach officinarum*)
- Maidenhair spleenwort (*Asplenium trichomanes*)



Southern maidenhair fern (*Adiantum capillus-veneris*)

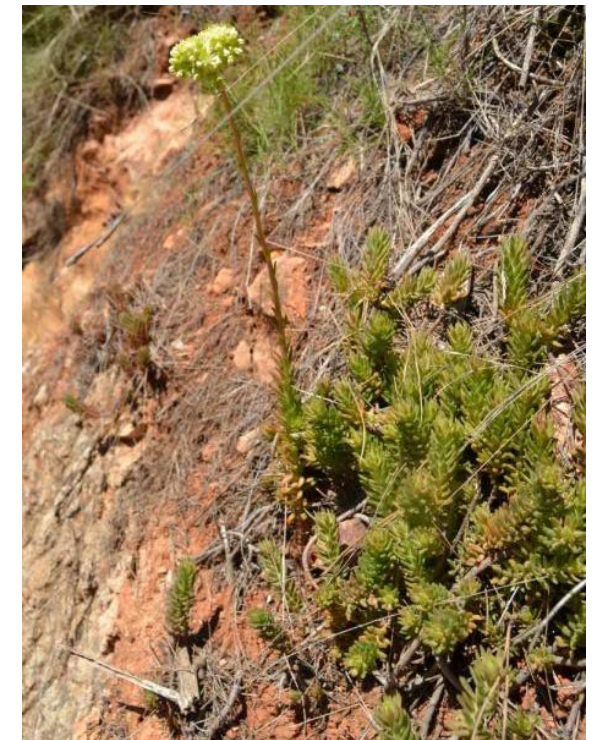
Higher plants

There are many species of small plants that are directly linked to the presence of stone walls. They notably include:

- Ivy-leaved toadflax (*Cymbalaria muralis*). This species introduces its fruit into cracks in walls, so their seeds, when they germinate, will be in optimal conditions for colonising the stone wall within a few years.



Caper bush (*Capparis spinosa*). Pedralbes monastery



Mediterranean stonecrop (*Sedum sediforme*)



Eastern pellitory-of-the-wall (*Parietaria officinalis*)



Ivy-leaved toadflax (*Cymbalaria muralis*).

FAUNA IN BUILDINGS

One of the measures for boosting urban biodiversity is putting up artificial nests for species that use buildings for nesting. Everyone is familiar with swallows and swifts, insectivorous and migratory species of birds which, coming from the African continent, reach our shores in the spring to breed. They can be easily spotted during the summer, especially during the start or end of the day, flying over buildings in search of flying insects. They play a very important role in controlling insect populations. They embark on their return journeys to the African continent during the summer or start of the autumn, seeking milder winter temperatures.



Alpine swifts (*Tachymarptis melba*) in flight. Photo: Oriol Alemany

Swallows

They have numerous problems finding muddy areas in the city and therefore quality material for building their nests from. The buildings' walls are often too smooth for their nests to cling to securely.

Creating bogs in open areas in parks and gardens and putting up artificial nests in suitable places are helpful measure for swallows. There are two species of the swallow genus found in Barcelona:

BARN SWALLOWS (*Hirundo rustica*)



Typical of rural milieus, though it is not rare to see them in the city in places near aquatic environments or large parks.



Barn swallow's artificial nest. Can Mestres. Photo: Eduard Durany

Nest: They build their nest out of mud and small plant fibres, in the shape of a pot which they locate in sheltered places such as roofs, attics, interior courtyards and warehouses.

Nesting: they breed at the end of May, laying batches of four to six eggs which they incubate for fourteen days, after which their chicks hatch, becoming fledglings at the end of roughly one month. They can lay a second batch. They are a species protected by Catalan regional legislation, so their nests may not be destroyed without authorisation from the Generalitat of Catalonia's Fauna Protection Service.



Barn swallow's nest. Photo: Eduard Durany

Initiative: we can help this species by putting up sheltered artificial nests over two metres high, to prevent predators from gaining access. They prefer sheltered places although these have open entrances and exits. Nests need to be 1 m to 2 m apart and it is advisable to leave between 6 cm and 8 cm between the nest and the ceiling.

COMMON HOUSE MARTIN (*Delichon urbicum*)



Photo: Sergi Garcia

They mainly rear in building façades along the outskirts of the city, though invariably in places that are close to open spaces which they use as feeding places.

Nest: they build their nests under balconies and eaves and normally group together in colonies. Unlike barn swallows, their nests are spherical and closed, and only present an entry and exit hole on one side at the top of the nest.



Nesting: they start breeding at the end of May, laying batches of six eggs, and their chicks take less than a month to become fledglings. They can lay a second batch. They are also a protected species under Catalan regional legislation.



Common house martin nests

Initiative: we can help this species by putting artificial nests on eaves and under balconies above a height of roughly 4 m.

Common swift and Alpine swift

These are two of the species we find in Barcelona and which use the city's buildings for establishing nesting places, normally situated in false ceilings, rain screens, ventilation chambers and party walls, among other things. They are a species that is completely adapted to living up in the air and it is in fact only during their breeding season that they use buildings to stay in and breed. They are able to sleep as they fly. It is worth highlighting their ecological value in controlling insect populations.

COMMON SWIFT (*Apus apus*)



Photo: Sergi Garcia

They can be distinguished from swallows by their completely dark plumage and by their narrower, scythe-shaped wings.

Nest: they occupy ventilation chambers, false ceilings, party walls and other structures, such as window-blind boxes, which they access through small cracks and holes. The sizes of their nests' entrance holes are 5 cm in diameter (round) or 3 cm x 7 cm (rectangular).

Phenology: they arrive in the spring and leave at the end of the summer.

ALPINE SWIFTS (*Tachymarptis melba*)



They are notable for their white belly and neck, separated by a brown pectoral strip, a feature which, along with being bigger than common swifts, distinguishes it from the latter.

Nest: they prefer to use rain-protected party walls or the side walls of buildings for building their nests. They form colonies that can contain a large number of individuals and form dormitories where hundreds of non-breeding individuals group together, as

can be found in the Camp Nou. The sizes of their nests' entrance holes are 8 cm in diameter (round) or 5 cm x 10 cm (rectangular).

Phenology: they arrive in March and leave at the start of November (later than common swifts).

Places with a sufficient height need to be looked for, if common and Alpine swift nests are to be put up. For Alpine swifts, the height would correspond to a building's fifth floor and for common swifts to at least a second floor, so these species can easily retake flight. The length of their wings prevents them from taking off from the ground. In any case, there are various strategies that can be followed to boost the presence of these birds in the city:

1. Making the most of redevelopment or new building work to put up artificial nests integrated into façades, which show a higher occupancy index than outdoor artificial nests.



Redevelopment work on a building's party wall in Carrer de Concepción Arenal. Observe the presence of entrance holes for swifts on the upper part. Photo: Sergi Garcia

2. Ensuring the redevelopment work on the buildings does not damage or block ventilation holes or other structures that can be used by these birds.

3. Making the most of new building work to adapt structures such as nesting substrates for these species.



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There are a wide variety of types of green spaces in urbanised milieus, with markedly different sizes and locations. Despite such heterogeneity, they share the fact that they are often subject to a large number of small initiatives that are favourable to plants and fauna on the part of the public itself. Because they are mostly private spaces, this encourages all those who enjoy them to take special care of them. Some are spaces for public use and belong to institutions, universities or religious-order buildings and, as such, enjoy good maintenance too. Note in this broad range the more than 50 reclaimed block interiors in Barcelona, from the Eixample district, spaces that have increased the presence of urban green in highly densified areas.



Green roof
Carrer Tarragona, 173

Interior gardens encourage biodiversity where, besides the more routine initiatives, initiatives are carried out which are aimed at boosting biodiversity. Such initiatives here notably include those that enable fauna to shelter, breed, feed or simply move around with ease from one place to another (playing a green-corridor role). All of this is beneficial for insects, birds, reptiles, amphibians and small mammals; in short, the scope of the initiatives will depend on the possibilities of each site. Some initiatives need a bit of space, as in the case of creating piles of rocks or wood, but others, such as nest boxes, can be carried out on modest balconies and roof terraces. From the city's perspective, it is not so important for the initiatives to be very intense in some places, as they are carried out wherever they are feasible, though more modestly.

Barcelona has a tradition of using balconies and roof terraces for a variety of roles, including landscaping. The City Council is working to launch a series of regulatory and technical terms and conditions for promoting the creation of green roofs. Green roofs represent a new stage of advancement in the city's naturalisation which involves several environmental benefits, including capturing rain water and absorbing CO₂, and dampening the effect known as "urban heat island", which makes the city's temperature higher than that of its surroundings. Moderating this effect results in a reduction of energy consumption derived from air-conditioning, besides creating a new urban landscape high up.



Poble Espanyol

Preserving cracks in façades and stone walls *for conserving habitats for birds, reptiles and invertebrates*



Columbrete wall lizard (*Podarcis liolepis*)

Description/application

➔ Holes must not be obstructed or cracks eliminated since these spaces allow the presence of animal life and offer places for birds, lizards, geckos and invertebrates to breed and rear their young in.

Preventing the presence of cats *to minimise their impact on fauna*



Cat colony

Description/application

➔ The predatory instinct of cats poses a risk to the preservation of urban biodiversity. Cats must therefore be relocated far away from spaces where there is a clear aim to establish conservation programmes and improve biodiversity.

Moderating the use of reaping and weeding machines in areas of use to fauna *to prevent their impact on fauna*



Description/application

Using reaping or weeding machines in areas of use to fauna, such as the surroundings of a pond or rocky area, can lead to high death rates among amphibian, reptile and invertebrate populations.

→ Care has to be taken when using such types of machinery during the breeding periods of fauna and maintenance work should be performed outside the breed period. In any case, if reaping or weeding work has to be carried out, it would be advisable to consider doing it from the outside in, to give fauna possibilities of escaping to shelter areas, and to cut as high as possible.

Putting adhesives on windows in landscaped areas *to prevent their impact on birds*



Parc del Centre in Poblenou

Description/application

The latest studies conducted in northern European countries show that the problem of birds colliding with the windows of buildings is much more significant than previously believed and is actually one of the main causes of unnatural death among birds. The transparency and mirror effect glass panes have as images of their environment, such as tree tops, gardens or even the sky itself, end up as a fatal trap for many species of birds, whether sedentary or migratory in the spring and autumn. Blackbirds, blackcaps, robins, chiffchaffs, thrushes and swifts, among other species, are affected by this problem.

→ To protect against such collisions adhesives need to be put on window panes to break their reflection. In this respect, it has recently been observed that the most effective measure is to put up strips of adhesive tape, 10 cm apart from one another.

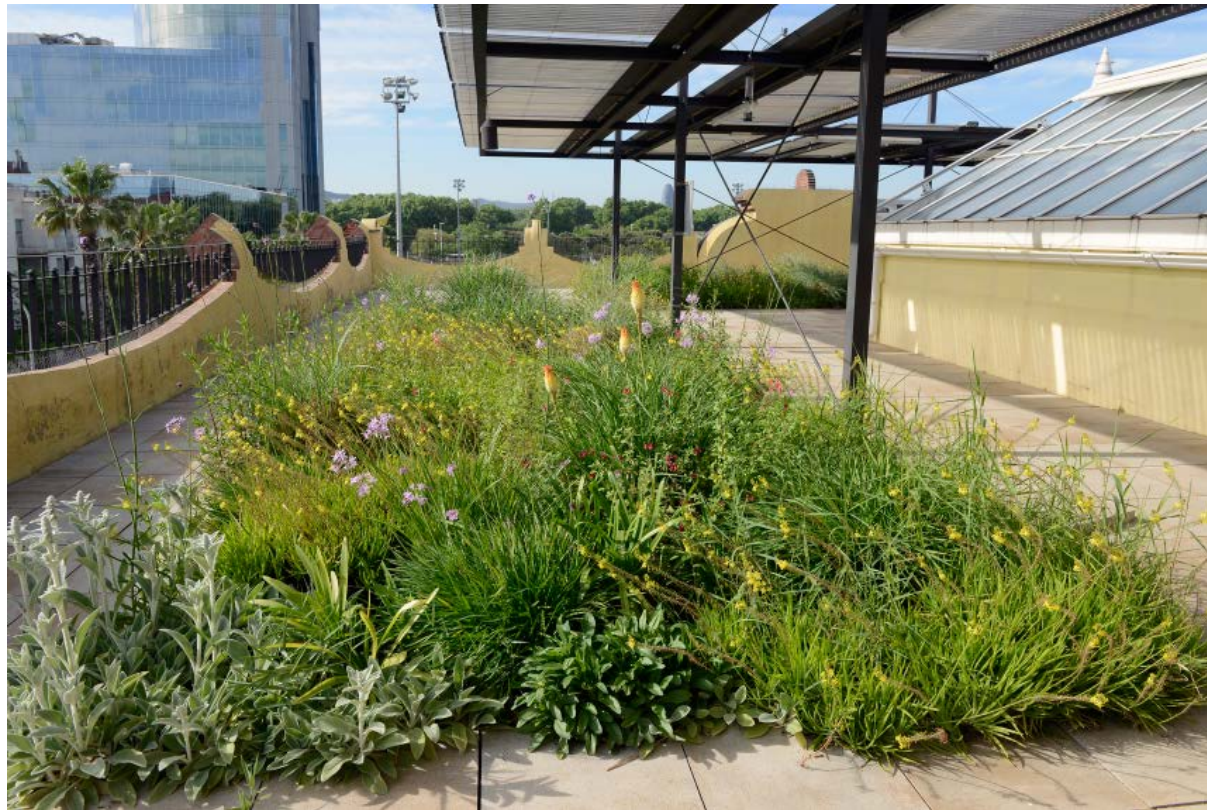
Adhesives, shaped as birds-of-prey silhouettes, were traditionally used to alert birds of the presence of a predator and thereby prevent them from colliding with windows. While it is true that this can prove effective for small windows with suitable densities (10 cm of separation), by breaking their mirror effect, the same cannot be said with large-surface windows.

There are two evident lines of work here. One for solving the problem of birds colliding against currently existing buildings, and the other for incorporating new criteria into the design of newly constructed buildings with translucent glass or incorporating screen prints inside that are visible to birds.



Screen-printed glass

Boosting green roofs and landscaped roof terraces to create a biodiverse habitat



Green roof Fàbrica del Sol

Description/application

Landsaped roofs and terrace roofs regarded as biodiversity spaces have to be geared towards creating a dense plant structure with a useful composition of flowers, to enable them to attract the interest of fauna and play, at the same time, a connecting role between green spaces. They are places colonised by flora and fauna spontaneously and rapidly become useful spaces for biodiversity.



Green roof Zona Nord Library

→ When it comes to selecting species, account has to be taken of elements such as native plants or plants that are well adapted to the Mediterranean climate, and therefore of low maintenance; flower types and their nectar value; retaining atmospheric pollutants and their invasive or allergenic potential and soil availability. Studies need to be conducted on the species of which these roofs and terrace roofs should be composed; the options are evidently diverse, but a good option in any case would be to use succulent or bulbous plants, such as wild garlic (*Allium* sp.) or species typical of fields and Mediterranean scrub. Common thatching grass (*Hyparrhenia hirta*), Mediterranean false-brome (*Brachypodium retusum*), Mediterranean stonecrop (*Sedum sediforme*), fennel (*Foeniculum vulgare*) and viper's bugloss (*Echium vulgare*) are a few good examples. (See **Grasses, fields and grasslands. Annexe 4: Mediterranean dry grasslands**).

→ The benefits for biodiversity are higher where the designs of such spaces provided for the introduction of a shrubby layer that increases the space's structural complexity, provided the available soil permits this.



Bearded iris (*Iris germanica*)



Narcissus (*Narcissus* sp.)



Eastern gladiolus (*Gladiolus communis*)

Beefing up plant cover on balconies, patios and roof terraces *to attract birds, reptiles and bats*



Urban allotment on the terrace roof of the Escola Nostra Senyora de Lurdes

Description/application

The opportunities offered by balconies, patios and roof terraces need to be taken advantage of, to establish or strengthen their plant cover and provide fauna with feeding, breeding and resting spaces, while also increasing the city's green infrastructure. An allotment, for example, turns terrace roofs and balconies into spaces that attract pollinating insects and insectivorous birds, among other things, by boosting biodiversity and connections between green spaces. It is therefore a very useful option.

For further information please consult Barcelona City Council's Guide to living roof terraces and green roofs. <http://cort.as/d21u>

Strengthening the creation of vertical gardens *to improve the city's flora and fauna usefulness*



Vertical garden

Description/application

→ The presence of free walls on balconies, in patios and on terrace roofs need to be exploited so that invertebrates, reptiles and birds can have places for sheltering, breeding and feeding.

→ Species have to be planted to boost plant covers in the form of climbing plants. (See **Shrub groups and hedges. Annexe 1: Shrubby plant of use to fauna**).



Escola de Jardineria Rubió i Tudurí work

Strengthening a quality shrubby layer to promote its fauna-sheltering role



Green roof at Servei Estació

Description/application

We need to ensure that courtyards, but above all small gardens, have a quality shrubby structure that offers local fauna places for breeding, feeding and sheltering and which enables them to move between urban green spaces.

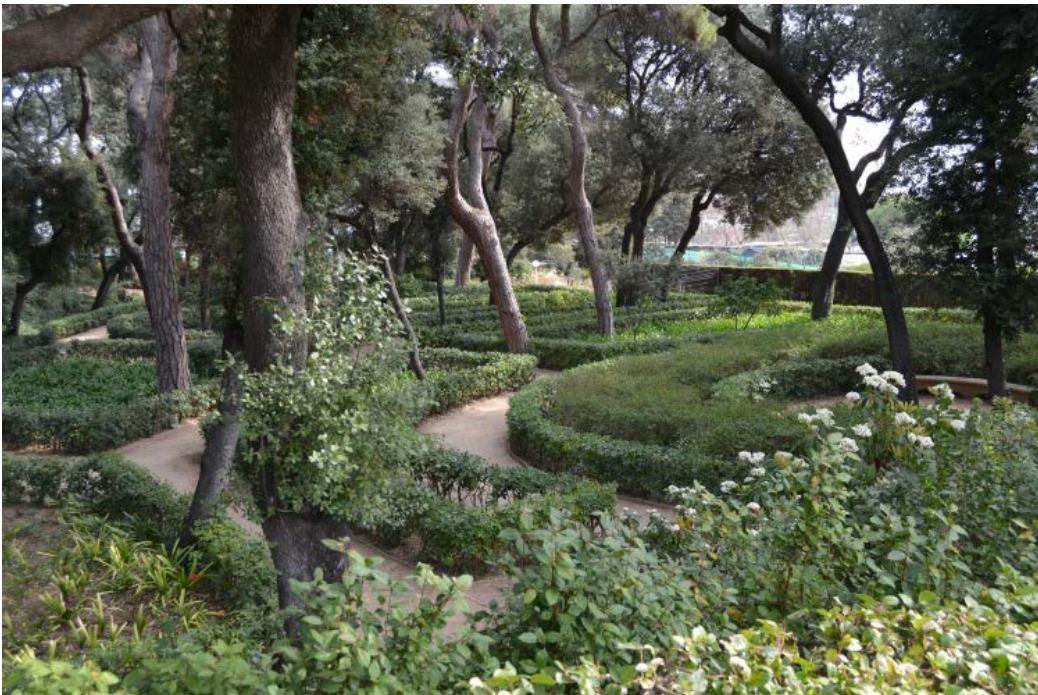
→ Native shrub species should be planted that have fewer maintenance needs and more interaction with local fauna, such as laurustinus (*Viburnum tinus*), mastic trees (*Pistacia lentiscus*), Mediterranean buckthorn (*Rhamnus alaternus*), strawberry trees (*Arbutus unedo*) and false olive trees (*Phillyrea angustifolia*). (See *Shrub groups and hedges. Annexe 3: Shrubby plants of use to fauna*).



Black hawthorn (*Rhamnus lycioides*)



Group of false olive tree (*Phillyrea angustifolia*) shrubs



Parc del Laberint d'Horta

Putting up nest boxes to encourage the presence of forest insectivorous birds and bats



Nest box for great tits (*Parus major*)

Description/application

→ Nest boxes need to be put up, to offer nesting opportunities to certain species of insectivorous and forest birds which have difficulty in urban contexts finding breeding places, due mainly to a lack of mature trees. Great tits (*Parus major*), European crested tits (*Lophophanes cristatus*), Eurasian blue tits (*Cyanistes caeruleus*), coal tits (*Periparus ater*) and short-toed treecreepers (*Certhia brachydactyla*) are regular nest-box users. The educational potential of the initiative should be exploited

Nest boxes must be located in places where birds can safely breed. For this reason, the following factors should be taken into account:

- Nest boxes should be put up in the middle of the winter. That is when birds start to look for suitable nesting places.
- Nest boxes should face south or south-west, especially in cold and shaded areas, to capture the morning sunshine.
- Nest boxes should be put up at a height of between 3 m and 7 m.



Nest box for Eurasian blue tits



Nest box for European robins



Nest box for short-toed treecreepers

- For small birds, nest boxes should be far from the main trunk, to make it hard for potential predators to access them.
- Hole sizes will determine the presence of one or another species.
- Nest boxes need to be maintained. Old nest boxes from previous seasons should be removed during the winter period, to prevent the plugging-up of nest boxes, and also cleaned inside, where possible, to protect against the presence of parasites, bacteria and fungi.

→ Artificial nests should be put up for bats. New building systems and the dearth of mature forests make it very difficult for these mammals to find suitable holes and cracks to shelter in. Artificial nests can therefore be put up for both their activity (breeding) and hibernation periods. There are many models of nest boxes for bats of various types on the market, but, in any case, the general criteria for putting them up are as follows:

- Height between 3 m and 5 m.
- Facing south or south-west. It is advisable for nest boxes to receive between 5 and 7 hours of sunshine a day.
- They can be hung from trees or building façades, provided there are no obstacles blocking the nests' entry and exit holes.

Putting up feeding boxes *to provide birds with food during the winter period*



Eurasian blue tit on a tubular feeding trough

Description/application

Under normal conditions, birds find the food they need for their development in the natural environment. In winter, however, given the low temperatures and scarcity of food resources, they can be offered a regular source of food and small birds therefore helped to get through harsh times.

The educational potential of the initiative should be exploited

→ Food should only be provided during the winter period. Outside that period, any additional food in feeding boxes can be counter-productive, as it can create a dependency among birds that must be avoided.

→ Feeding boxes should be located beyond the reach of cats and other predators.

→ Feeding boxes must be regularly cleaned.

→ Watering troughs with clean water should be provided.

→ Types of food:

- Grain and seeds: wheat, barley, maize, millet etc. There are also commercial preparations. Granivorous birds from the finch family such as greenfinches, goldfinches and serins, as well as wood pigeons (*Columba palumbus*) and Eurasian collared doves (*Streptopelia decaocto*), will use them.
- Dried seeds and nuts: peanuts, sunflower seeds etc. It is important for the dried seeds and nuts to be treated with anti-fungal products and to ensure they can withstand the elements. They will be greatly appreciated by tits and finches
- Sweet fruit. Appreciated by common blackbirds (*Turdus merula*), song thrushes (*Turdus philomelos*) and Eurasian blackcaps (*Sylvia atricapilla*), among other species
- Live worms: earthworms and cockroach larvae and mealworms for insectivorous birds such as black redstarts (*Phoenicurus ochruros*) and white wagtails (*Motacilla alba*).
- Salted or toasted products must not be given.



Home-made feeding bowl made from a coconut shell. Drainage holes are required to prevent the build-up of water.

Putting up insect hotels to boost the presence of pollinators in courtyards, gardens and balconies



Insect hotel. Jardí Botanic

Description/application

→ Many hymenoptera species (ants, bees and wasps) live in empty holes and can therefore be provided with nesting substrates. There are numerous possible combinations both in the materials used (sawdust, wood, reed, clay, plant materials etc.,) and in the diameters of the holes. They host several species, depending on these parameters.

→ Account should be taken of the educational potential of these constructions where they are built with transparent materials that enable monitoring of laid eggs, the growth of larvae in their rearing cells and the emergence of adults.



Insect hotel using reed from the allotment

Putting up insect spirals to boost the presence of pollinators in courtyards, gardens and balconies



Insect spiral.
Permaculture group
Bosc Turull

Description/application

Insect spirals are extremely useful structures for biodiversity which help to attract a large number of pollinating insects. With this goal in mind, it is important to work with plants whose flowers blossom over long periods and contain a notable nectar content and which are also perfectly adapted to the Mediterranean climate.

→ When making the final choice for the plant species that the insect spiral is to consist of, account should be taken of such aspects as the presence or absence of irrigation systems, the degree of sunshine the structure receives, ornamental criteria, the environment and the use that the public makes of the space in question. In any case, planting aromatic species such as lavender, rosemary, thyme, sage, prostrate Canary clover, hyssop, santolina and common shrubby everlasting can prove to be extremely useful. (*See annexe 1: Plants for butterfly gardens*).

→ Dry stone walls offer shelter for a large number of invertebrates, small reptiles - such as lizards and geckos - and amphibians, where there are nearby sheets of water. All of these will therefore find shelter among the cracks and holes of the spiral, thereby considerably increasing the space's biodiversity.

One option also worth considering is inserting small insect hotels made up of trunks and other perforated plant materials into the spiral's walls so solitary bees can find nesting substrates there.

→ It is strongly advisable to use gabions as a building element for stone walls in gardens if you are considering putting up an insect spiral and the environment's urban-context dynamics raise concerns over the possibility of acts of vandalism.

Boosting the presence of useful flora in courtyards, gardens and balconies *to increase the presence of butterflies and other pollinating insects*



Jardí per a la biodiversitat. Parc de Joan Miró

Description/application

Nectar-producing plants in courtyards, gardens and small balconies attract butterflies and other pollinating insects. What is more, some of these plants are used by adult butterflies as host plants. (See **annexe 1: Plants for butterfly gardens**).

→ If you are considering building a butterfly garden, bear in mind the following:

- Put it in a sunny place that is protected from the wind.
- Group together the chosen species according to their maintenance needs and giving priority to native plants.



Echium fastuosum

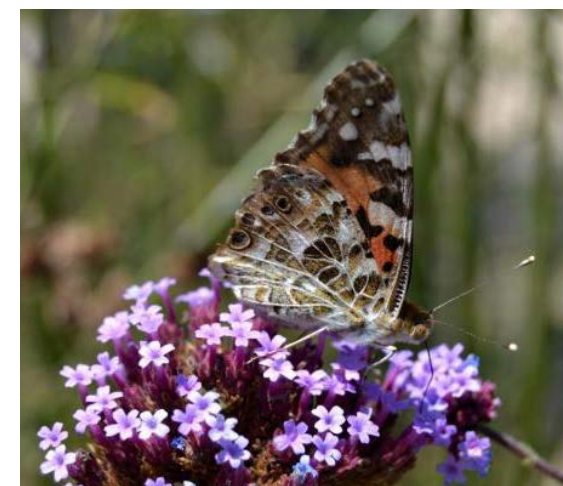
- Choose species that blossom in the spring, others that do so in the summer and others in the autumn, to ensure a long period of flowering.
- Choose species with flowers of several colours.
- Put together at least three or four units of each plant species.
- Plant host species, such as legumes or grasses.
- Offer empty spaces so ruderal species such as fennel, thistle and mallow can establish themselves there.
- Create small bogs so butterflies can sip mineral salts from the earth.



Jardí per a la biodiversitat. Parc de Joan Miró



Hemerocallis sp. Parc del Torrent Maduixer



Painted lady (*Vanessa cardui*) on purpletop vervain (*Verbena bonariensis*)



Pea blue (*Lampides boeticus*) sipping from a Spanish broom (*Spartium junceum*) flower

Creating bogs for swallows *to help them with building their nests*



Description/application

Swallows from Africa arrive here every spring to remake or start building their nests and enter their nesting and breeding period.

A good-quality bog is required for that purpose.

- ➔ Bogs have to be located in open spaces without very much vegetation.
- ➔ It is advisable for the mud there to have a clayey texture so it is consistent when it dries.

Naturalising ponds and ornamental fountains *to boost aquatic flora and fauna*



Monestir de Pedralbes' irrigation pond

Description/application

A type of management should be carried out based on the fact that it is the aquatic system itself that is self-regulated, through the natural balance of its fauna and flora.

- ➔ If necessary, access and exit ramps should be installed so that amphibians can complete their life cycles and other fauna that accidentally fall in have a chance to get out and escape from drowning. There need to be structures in place that connect the pond's interior with the outside.

Creating rock piles *to attract reptiles and invertebrates*



Rock pile. Tres Pins Plant Nursery

Description/application

Rock piles create opportunities for mainly lizards and invertebrates to colonise them. Sunny sites need to be found.



Building piles or pyramids of wood *to attract wood-eating insects*



Piled-up wood. Tres Pins Plant Nursery

Description/application

Wood gives xylophagous (dead-wood-eating) insects opportunities for feeding, given that they take part in decomposition processes of organic matter and are also at the bottom of the food chain for many groups of fauna.

➔ Such wood can come from leftovers from pruning and small piles of wood can be opted for, as well as more elaborate constructions such as pyramids, which partially bury the base of vertically laid-out trunks. In such cases, besides their biodiversity-related aspects, it is worth considering the aesthetic value that they bring the site.

Accumulating litterfall *to increase the number of invertebrate fauna*



Columbrete wall lizard (*Podarcis liolepis*)

Description/application

→ Litterfall should be accumulated in garden areas that are rarely visited. That would speed up the organic matter's natural decomposition processes and increase biodiversity.

Putting up watering troughs *to attract fauna in courtyards, gardens or balconies*



Description/application

→ The availability of water in gardens, balconies and courtyards is becoming a key factor in determining the presence of local fauna. Watering troughs should be located in accessible places. Of course, their maintenance needs to be monitored to protect these watering troughs from turning into breeding points for mosquitoes.

PLANTS FOR BUTTERFLY GARDENS

Herbaceous plants

Scientific name	Common name	Flowering	Colour	Value
<i>Alyssum maritimum</i>	Sweet alyssum	Sp/Sm/A/W	White	Nectar
<i>Aphyllanthes monspeliensis</i>	Blue aphyllanthes	Sp	Blue	Nectar
<i>Aster sedifolius</i>	Michaelmas daisy	A	Blue	Nectar
<i>Asteriscus maritimus</i>	Canary Island daisy	Sp/Sm	Yellow	Nectar
<i>Centaurea sp.</i>	Centaury	Sp/Sm	Blue	Nectar and HP of painted ladies
<i>Centranthus ruber</i>	Kiss-me-quick	Sp/S/A	Purple	Nectar
<i>Cirsium vulgare</i>	Creeping thistle	E	Rose	Nectar and HP of painted ladies
<i>Crithmum maritimum</i>	Rock samphire	Sp/Sm/A/W	Yellow/green	Nectar
<i>Daucus carota</i>	Wild carrot	Sp/S/A	White	Nectar and HP of painted ladies
<i>Diploxix erucoides</i>	White rocket	Sp/Sm/A/W	White	Nectar and HP of small cabbage whites and bath whites
<i>Dittrichia viscosa</i>	False yellowhead	A	Yellow	Nectar
<i>Echium vulgare</i>	Viper’s bugloss	Sp/Sm/A/W	Blue	Nectar
<i>Eryngium maritimum</i>	Sea holly	Sp	Blue	Nectar
<i>Eryngium campestre</i>	Field eryngo	Sp/Sm	White	Nectar
<i>Foeniculum vulgare</i>	Fennel	E	Yellow	Nectar and HP of southern scarce swallowtails
<i>Galactites tomentosa</i>	Purple milk thistle	Sp/Sm	Rose	Nectar and HP of painted ladies
<i>Heliotropium europaeum</i>	European turn-sole	E	White	Nectar
<i>Hypericum balearicum</i>	Majorca St John’s wort	Sp/Sm	Yellow	Nectar
<i>Lathyrus latifolius</i>	Perennial peavine	Sm/A	Rose	Nectar
<i>Lepidium draba</i>	Whitetop	Sp	White	Nectar and HP of southern scarce swallowtail and small cabbage whites
<i>Lotus corniculatus</i>	Common bird’s-foot trefoil	Sp/S/A	Yellow	Nectar and HP of dark clouded yellow, pea blue and common blue
<i>Malva sylvestris</i>	Common mallow	Sp/Sm	Rose	Nectar and HP of painted ladies
<i>Medicago sativa</i>	Alfalfa	Sp/S/A	Blue	Nectar and HP of dark clouded yellow, pea blue, common blue and Lang’s short-tailed blue.

Scientific name	Common name	Flowering	Colour	Value
<i>Parietaria officinalis</i>	Eastern pellitory-of-the-wall	Sp/Sm	Colourless	HP of red admirals
<i>Psoralea bituminosa</i>	Pitch trefoil	Sp/S/A	Blue	Nectar
<i>Reichardia picroides</i>	Brighteyes	Sp/Sm/A/W	Yellow	Nectar
<i>Saponaria ocymoides</i>	Rock soapwort	Sp/Sm	Rose	Nectar
<i>Scabiosa atropurpurea</i>	Mourningbride	Sp/Sm/A/W	Blue	Nectar
<i>Sedum album</i>	White stonecrop	Sp/Sm	White/yellow	Nectar
<i>Silybum marianum</i>	Milk thistle	E	Rose	Nectar and HP of painted ladies
<i>Sonchus tenerrimus</i>	Slender sowthistle	Sp/Sm/A/W	Yellow	Nectar
<i>Tropaeolum majus</i>	Garden nasturtium	E	Yellow/orange	HP of large white and small white butterflies
<i>Trifolium pratense</i>	Red clover	Sp/S/A	White	Nectar and HP of dark clouded yellow, pea blue and common blue
<i>Urtica dioica</i>	Common nettle	Sp/Sm	Colourless	Nectar and HP of red admirals
<i>Viola alba</i>	White violet	Sp/W	Blue	Nectar

Sp = spring, Sm = Summer, A = autumn, W = winter, HP = host plant

Aromatic plant

Scientific name	Common name	Flowering	Colour	Value
<i>Foeniculum vulgare</i>	Fennel	Sm/A	Yellow	Nectar and HP of southern scarce swallowtails
<i>Helichrysum italicum</i>	Curry plant	E	Yellow	Nectar
<i>Helichrysum stoechas</i>	Curry plant	Sp/Sm	Yellow	Nectar
<i>Hyssopus officinalis</i>	Hyssop	Sm/A	Blue	Nectar
<i>Lavandula stoechas</i>	Spanish lavender	Sp	Blue	Nectar
<i>Marrubium vulgare</i>	Japanese mock orange	Sp/A	White	Nectar
<i>Lavandula angustifolia</i>	Lavender	E	Blue	Nectar
<i>Lavandula stoechas</i>	Spanish lavender	Sp	Blue	Nectar
<i>Matricaria recutita</i>	Camomile	Sp/S/A	White	Nectar
<i>Melissa officinalis</i>	Lemon balm	Sp/Sm	Colourless	Nectar
<i>Mentha suaveolens</i>	Apple mint	E	White	Nectar
<i>Origanum vulgare</i>	Orenga	Sp/Sm	Common mallow	Nectar
<i>Rosmarinus officinalis</i>	Rosemary	Sp/S/A	Blue	Nectar and HP of Lang’s short-tailed blue
<i>Ruta chalepensis</i>	Fringed rue	Sp/Sm	Yellow	Nectar and HP of southern scarce swallowtails
<i>Ruta graveolens</i>	Common rue	E	Yellow	Nectar and HP of southern scarce swallowtails
<i>Salvia officinalis</i>	Sage	Sp	Blue	Nectar
<i>Santolina chamaecyparissus</i>	Cotton lavender	Sp/Sm	Yellow	Nectar
<i>Satureja calamintha</i>	Lesser Calamint	Sm/A	Blue	Nectar
<i>Satureja montana</i>	Winter savory	Sm/A	White	Nectar
<i>Thymus vulgaris</i>	Common thyme	Sp	Blue	Nectar and HP of Panoptes blue

Sp = spring, Sm = Summer, A = autumn, W = winter, HP = host plant

Shrubby scrubs

Scientific name	Common name	Flowering	Colour	Value
<i>Asparagus acutifolius</i>	Wild asparagus	E	Yes	
<i>Cistus albidus</i>	Grey-leaved cistus	Sp	Pollen	Green hairstreak
<i>Cistus monspeliensis</i>	Montpellier cistus	Sp	Pollen	
<i>Cistus salviifolius</i>	Sage-leaved rock-rose	Sp	Pollen	Green hairstreak
<i>Dorycnium pentaphyllum</i>	Prostrate Canary clover	Sp/Sm	Yes	

Sp = spring, Sm = Summer, A = autumn, W = winter, HP = host plant

Shrubs, climbing plants and bramble bushes

Scientific name	Common name	Flowering	Colour	Value
<i>Anthyllis cytisoides</i>	N/A	Sp/Sm	Yellow	Nectar
<i>Arbutus unedo</i>	Strawberry tree	A/W	White	Nectar and HP of two-tailed pashas
<i>Bupleurum fruticosum</i>	Shrubby hare’s ear	Sp/Sm	Yellow	Nectar
<i>Buxus sempervirens</i>	Boxwood	Sp	White	Nectar
<i>Calluna vulgaris</i>	Common heather	Sm/A	Rose	Nectar
<i>Cornus sanguinea</i>	Common dogwood	Sp	White	Nectar
<i>Crataegus monogyna</i>	Common hawthorn	Sp	White	Nectar and HP of scarce swallowtails
<i>Erica arborea</i>	Tree heath	Sp/W	White	Nectar
<i>Erica multiflora</i>	Heather	A/W	Pink/white	Nectar
<i>Hedera helix</i>	Common ivy	A	White	Nectar and HP of holly blues
<i>Ilex aquifolium</i>	Common holly	Sp/Sm	White	Nectar
<i>Laurus nobilis</i>	Sweet bay	Sp	White	Nectar
<i>Lonicera implexa</i>	Minorca honeysuckle	Sp	White	Nectar and HP of two-tailed pashas
<i>Phlomis herba venti</i>	Rough-leaved Jerusalem sage	Sp/Sm	Yellow	Nectar
<i>Lycium europaeum</i>	Box-thorn	Sp/Sm	Lilac/white	Nectar
<i>Pistacia lentiscus</i>	Mastic tree	Sp	Red/yellow	Nectar
<i>Prunus spinosa</i>	Blackthorn	Sp	White	Nectar and HP of scarce swallowtails
<i>Quercus coccinea</i>	Scarlet oak	Sp	Yellow	Pollen
<i>Rhamnus alaternus</i>	False olive	Sp	Yellow/green	Nectar and HP of Cleopatra butterflies and common brimstones
<i>Rosa canina</i>	Dog-rose	Sp	Rose	Nectar
<i>Rosa sempervirens</i>	Evergreen rose	Sp	White	Nectar
<i>Rubus idaeus</i>	Red raspberry	Sp/Sm	White	Nectar
<i>Rubus ulmifolius</i>	Elmleaf blackberry	Sp	White/pink	Nectar and HP of holly blues
<i>Sambucus nigra</i>	Elderberry	Sp	White	Nectar
<i>Sarothamnus scoparius</i>	Scotch broom	Sp	Yellow	Nectar
<i>Spartium junceum</i>	Spanish broom	Sp	Yellow	Nectar and HP of pea blues
<i>Ulex parviflorus</i>	Gorse	Sp	Yellow	Pollen
<i>Viburnum tinus</i>	Laurustinus	W/Sp	White	Nectar
<i>Vitex agnus-castus</i>	Chaste tree	Sp/Sm	Blue	Nectar

Sp = spring, Sm = Summer, A = autumn, W = winter, HP = host plant

DIURNAL BUTTERFLIES

Butterflies are regarded as bio-indicators as they are highly sensitive to environmental changes. Such features, along with the fact they are greatly socially accepted and easy to monitor, have helped to establish butterfly monitoring networks.

More specifically, a butterfly-population monitoring project was launched in Catalonia in 1994, called the Catalan Butterfly Monitoring Scheme (CBMS). It involves discovering the changes in butterfly numbers by conducting weekly visual censuses to relate them to environmental factors.

We should also mention that while it is true that there are no big differences between native and alien plants as far as the nectar value of their flowers goes, the caterpillars of many of the butterflies found in the city’s parks and gardens use specific species or families of native plants for feeding on.

Preliminary concepts:

Voltinism: this is the number of generations a species of butterfly goes through in the space of a year. So, depending on the species and climate conditions, there can be univoltine, bivoltine, trivoltine or polyvoltine butterflies, depending on whether they present one, two, three or more generations over the year.

Hilltopping: this is a form of behaviour presented by the males of some species which involves defending mating territories in geographically high-up areas such as a hill or mountain tops. Once the territories have been established, each male will defend its area aggressively and push out any other male.

The main species that can be found in Barcelona’s parks and gardens are:

Família papilionidae

OLD WORLD SWALLOWTAIL (*Papilio machaon*)



Description: besides being easily identifiable by its size, this is one of the most spectacular butterflies owing to its yellowish colour and black vein markings and because each of its wings has a red-and-yellow pigment pit and a tail. It is also noted for the way it flies.

Phenology: univoltine, bivoltine or trivoltine depending on the latitude, altitude and climatology of the season. At our latitudes: trivoltine Can be observed from February to October.

Habitat: Common in ruderal areas and fields. Its presence is determined by its host plant.

Host plant: fennel (*Foeniculum vulgare*), wild carrot (*Daucus carota*), tree thorough-wax (*Bupleurum frutescens*), parsley (*Petroselinum crispum*) and rue (*Ruta graveolens* and *R. chalepensis*), among other species.

Curiosities: males from this species exhibit hilltopping.

SCARCE SWALLOWTAIL (*Iphiclides feisthamelii*)



Photo: Wikimedia

Description: they have long tails that end with a white point and a zebra pattern that makes them unmistakable.

Phenology: at our latitudes: bivoltine. Can be observed from March to the end of August, although they can give rise to a partial third generation in low areas in September.

Habitat: very diverse, from shrubby areas or woody borders to herbaceous and open zones as well as rocky slopes. They are also common in ruderal areas and fruit-tree fields.

Host plant: species from the genus *Prunus*, such as wild cherry trees (*Prunus avium*), plum trees (*P. domestica*) and peach trees (*P. persica*). Common hawthorn (*Crataegus monogyna*), common pear tree (*Pyrus communis*) and cultivated apple tree (*Malus domestica*) are also its host plants.

Curiosities: males exhibit hilltopping behaviour.

Family Pieridae

LARGE WHITE (*Pieris brassicae*)



Description: White with black points on its front wings. It presents sexual dimorphism, as its females have two round black marks on the obverse of its front wings, marks that are absent in males.

Phenology: polyvoltine. Can be observed from March to October. Migratory.

Habitat: very common in gardens, crop areas and ruderal zones with nectar-rich flowers, such as thistles and centaureas.

Host plant: many species of crucifers and capparaceae, such as caper bush (*Capparis spinosa*), and Tropaeolaceae, such as garden nasturtium (*Tropaeolum majus*).

Curiosities: its caterpillars are a pest in cabbage crops and noted for their aposematic colouration, that is, their set of colours warning predators of their chemical defences. Its larvae are parasitised by several species of hymenoptera.



It lay its eggs on the underside of cabbage leaves.

SMALL WHITE (*Pieris rapae*)



Description: as it suggests, it is smaller than the large white. It is white or yellowish and also presents black spots at the tips of its wings.

Phenology: polyvoltine. Can be observed from March to November.

Habitat: very common in open areas in gardens and allotments and in ruderal environments.

Host plant: preferably crucifers such as wild cabbage (*Brassica oleracea*), but also chenopodiaceae and capparaceae, among other plants.

Curiosities: it is a common pest in cabbage crops, which its caterpillars feed on. Its caterpillars are frequently parasitised by hymenoptera.

DARK CLOUDED YELLOW (*Colias crocea*)



Description: orangey yellow in colour, with black spots. This species presents sexual dimorphism: in contrast to males, females have yellow spots along their wings' black borders. .

Phenology: polyvoltine. Can be observed from March to November. Migratory.

Habitat: common in fields and open spaces with abundant flowers.

Host plant: a great variety of species from the legume family such as alfalfa (*Medicago sativa*), red clover (*Trifolium pratense*) and other species from the genera *Coronilla*, *Astragalus*, *Vicia* and *Anthyllis*, to name but a few.

COMMON BRIMSTONE (*Gonepteryx rhamni*)



Photo: Wikimedia

Description: presents a sexual dimorphism in its colouration, as males are lemon-yellow in colour whereas females are pale green. Its females are practically indistinguishable from *Gonepteryx cleopatra* females.

Phenology: univoltine. It hibernates as an adult and can therefore be observed from February up to October.

Habitat: very common in humid woody areas, although thanks to its mobility it also appears in markedly arid areas.

Host plant: Mediterranean buckthorn (*Rhamnus alaternus*) and other species from the same genus.

Curiosities: undergoes vertical migration in Mediterranean areas in the summer, looking for sources of nectar from lilac-coloured flowers such as those of viper's bugloss (*Echium vulgare*).

CLEOPATRA BUTTERFLY (*Gonepteryx cleopatra*)



Description: the species presents a pronounced sexual dimorphism whereby the males stand out for the large orange spot, which is absent in females, on their front wings. *G. Cleopatra* males can be easily distinguished from *G. rhamni* males by the absence of these orange spots.

Phenology: bivoltine. It also hibernates as an adult and can therefore be observed from February to August.

Habitat: very common in arid and dry Mediterranean environments.

Host plant: Mediterranean buckthorn (*Rhamnus alaternus*)

Curiosities: undergoes vertical migration in Mediterranean areas in the summer, looking for sources of nectar from lilac-coloured flowers such as those of viper’s bugloss (*Echium vulgare*).

WESTERN DAPPLED WHITE (*Euchloe crameri*)



Description: its upper side is white with black spots and its lower side is silvery with well-defined grey and greenish spots.

Phenology: bivoltine. Can be observed from February to October.

Habitat: appears in lowland farm and ruderal areas.

Host plant: various crucifer.

BATH WHITE (*Pontia daplidice*)



Description: resembles the western dappled white. They can be distinguished by examining whether the upper border of their front wings have crosswise stripes (*E. crameri*) or not (*P. daplidice*). The pattern on the underside of the wings is also different.

Phenology: polyvoltine. Can be observed from March to October. Migratory.

Habitat: ruderal and arid environments.

Host plant: *Reseda lutea* and several crucifer.

Family Lycaenidae

COMMON BLUE (*Polyommatus icarus*)



Description: it is the commonest of all the gossamer-winged butterflies and, as with the other species in this family, its females are brown and more difficult to see whereas its males are electric sky blue.

Phenology: polyvoltine. Can be observed from March to October.

Habitat: it is a species capable of colonising very different environments such as fields, abandoned crops and ruderal areas.

Host plant: several species of legumes such as red clover (*Trifolium pratense*), alfalfa (*Medicago sativa*), common bird’s-foot trefoil (*Lotus corniculatus*) and Spanish broom (*Spartium junceum*).

PEA BLUE (*Lampides boeticus*)



Description: its males are violet blue and its females grey brown. The underside of its wings is brown with wavy white lines and is notable for its highly visible white stripe. Also notable are the tails on its back wings.

Phenology: polyvoltine. It can be observed from April to October, except when it hibernates as an adult. Migratory.

Habitat: common in markedly arid areas such as scrubs and maquis shrubland where Spanish broom is found. And in cultivated and ruderal areas with flowers.

Host plant: many species of legumes such as Spanish broom (*Spartium junceum*) and alfalfa (*Medicago sativa*).

Curiosities: it can be a serious pest for peas (*Pisum sativum*). Male exhibit hilltopping behaviour.

LANG’S SHORT-TAILED BLUE (*Leptotes pirithous*)



Description: Resembles pea blue but can be distinguished from it as it is smaller and lacks the white stripe found on the other’s back wings. Its males and females have the same colouring as their pea blue counterparts.

Phenology: polyvoltine. Migratory. It arrives in Catalonia from the African continent in May or June and can be observed until October.

Habitat: ruderal borders and areas, and also abundant in alfalfa and red clover fields.

Host plant: alfalfa (*Medicago sativa*), red clover (*Trifolium pratense*), gorse (*Ulex parviflorus*) and rosemary (*Rosmarinus officinalis*).

Curiosities: pea blue and Lang’s short-tailed blue fly fast and in a way that is difficult to distinguish.

GERANIUM BRONZE (*Cacyreus marshalli*)



Description: it has a brown back along with grey and brown stripes on the underside of its wings.

Phenology: Can be observed from April to October.

Habitat: towns and cities where geraniums are used as an ornamental plant.

Host plant: geraniums (*Pelargonium sp.*).

Curiosities: a species introduced from South Africa in 1990 when geraniums were imported to the Balearic islands. Its larvae prefer to feed on flowers and buds, though it can affect any part of the plant above ground.

Nymphalidae Family

PAINTED LADY (*Cynthia cardui*)



Description: the underside of the wings have a reddish background with white and black spots. Its back is clearer, with small blue pigment pit on the lower part.

Phenology: polyvoltine. Can be observed from April to November. Migratory *par excellence*, it comes over in the spring, from north Africa, to breed in the Mediterranean.

Habitat: shows a preference for open and ruderal areas with thistles. Even so, thanks to its considerable mobility, it can be found in very different environments.

Host plant: thistles from the genera *Cirsium*, *Cardus* and *Galactites*, but also genera such as *Echium*, *Malva* and *Urtica*.

Curiosities: every few years in mid-May, a huge number of them appear, moving north.

RED ADMIRAL (*Vanessa atalanta*)



Description: black with white and red spots.

Phenology: univoltine. Can be observed from March to October. Migratory.

Habitat: very diverse, though common in humid and stream areas.

Host plant: nettles and eastern pellitory-of-the-wall.

Curiosities: a large number can be seen arriving in October and November, hailing from northern and central Europe, which come over to hibernate in the Mediterranean area. The offspring of these develop during the winter to give rise to a generation appearing in March-April that will subsequently colonise central and northern Europe.

TWO-TAILED PASHA (*Charaxes jasius*)



Photo: Wikimedia

Description: it is Europe’s largest diurnal butterfly and one of its most spectacular. It is brown with a wide orangey margin dorsally and striped ventrally. Also notable are the two tails on its back wings.

Phenology: bivoltine. The first generation is from May to July and the second from August to October.

Habitat: Mediterranean woody and maquis areas with strawberry trees. It is especially abundant where there are cork oaks.

Host plant: Strawberry tree (*Arbutus unedo*)

Curiosities: this species is strongly territorial and exhibits hilltopping behaviour. Males and females are attracted by the alcohol produced from fermenting strawberry tree fruit, which enables them to locate strawberry trees and lay their eggs in their leaves so their caterpillars can feed on them until they become pupae. They can often be seen sipping mineral salts over excrement.

SPECKLED WOOD (*Pararge aegeria*)



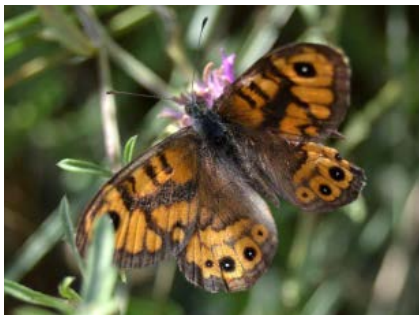
Description: brown with orangey spots.

Phenology: polyvoltine. Can be observed from February to November.

Habitat: Humid areas, brooks, gardens and woods. Shows a preference for shaded areas where its males, which are very territorial, can frequently be observed sunbathing on leaves and forest floors.

Host plant: various grasses that include *Brachipodium*, *Agrostis* and *Cynodon*.

WALL BROWN (*Lasiommata megera*)



Description: brown with orangey spots.

Phenology: polyvoltine. Can be observed from February to November.

Habitat: very diverse, including dry fields, fields with flower, ruderal areas, rocky areas or clearings in forest areas.

Host plant: various grass genera that include *Brachipodium* and *Agrostis*.

Curiosities: it resembles speckled wood, even though wall brown shows a preference for drier and sunnier environments. Males exhibit hilltopping behaviour.

SPANISH GATEKEEPER (*Pyronia bathseba*)

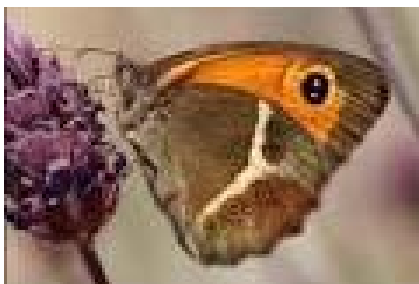


Photo: Wikimedia

Description: it has orange wings with brown edges and a black pigment pit on its front wings, as well as pigment pits on its back wings, which distinguishes it from *P. cecilia*. The underside of its back wings is noted for the creamy band traced by highly visible pigment pits, another feature for distinguishing the two species.

Phenology: univoltine. Can be observed from April to July.

Habitat: fields, thickets and open woods.

Host plant: Mediterranean false-brome (*Brachypodium retusum*) and common thatching grass (*Hyparrhenia hirta*).

SOUTHERN GATEKEEPER (*Pyronia cecilia*)



Photo: Wikimedia

Description: its wings are orange with brown edges and a black pigment pit on its front wings. Unlike *P. batsheba*, it has no pigment pits on its back or on the underside of its back wings.

Phenology: univoltine. Can be observed from July to September.

Habitat: thickets and dry fields.

Host plant: common thatching grass (*Hyparrhenia hirta*) and Mediterranean false-brome (*Brachypodium retusum*).

IBERIAN MARBLED WHITE (*Melanargia lachesis*)



Description: white with black spots.

Phenology: univoltine. Can be observed from May to July.

Habitat: shrubby and dry herbaceous areas with flowers.

Host plant: various grass genera that include *Brachipodium*, *Agrostis* and *Dactylis*.

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- Macroinvertebrates II. Consortium for the defence of aquatic fauna in the Besòs basin www.besos.cat
- Projecte Basses del Grup de Naturalistes d'Osona www.ichnosona.iec.cat/
- Projecte Rius www.projecterius.org
- Vivers Carex www.carex.cat

Cliffs, walls and party walls

- Catalogue of spaces of natural interest in the city of Barcelona. Depana and Barcelona City Council.
- Guideline criteria for exceptional initiatives in the face of conflicts created by the presence of protected fauna in the urban environment. General Manager's Office for the Natural Environment. Generalitat of Catalonia
- Buildings and biodiversity. Barcelona City Council
- Buildings and biodiversity. Generalitat of Catalonia
- The biological role of dry stone walls. Naturalea. Albert Sorolla Edo.

Useful addresses:

- Fauna in buildings www.faunaenedificis.gencat.cat
- Galanthus www.asgalanthus.org
- [http://agricultura.gencat.cat/ca/ambits/medi-natural/fauna-flora-animals-companyia/fauna- autoctona/fauna-salvatge-protegida-medi-urba/as-sessorament-tecnic/exemples-nius- artificials-caixes-niu/](http://agricultura.gencat.cat/ca/ambits/medi-natural/fauna-flora-animals-companyia/fauna-autoctona/fauna-salvatge-protegida-medi-urba/as-sessorament-tecnic/exemples-nius-artificials-caixes-niu/)
- [http://agricultura.gencat.cat/ca/ambits/medi-natural/fauna-flora-animals-companyia/fauna- autoctona/fauna-salvatge-protegida-medi-urba/ problemes-solucions/criteris-compatibilitzacio-fauna-protegida-edificis/](http://agricultura.gencat.cat/ca/ambits/medi-natural/fauna-flora-animals-companyia/fauna-autoctona/fauna-salvatge-protegida-medi-urba/problemes-solucions/criteris-compatibilitzacio-fauna-protegida-edificis/)

Courtyards, small gardens, balconies, terraces and green roofs

- Bird-Safe Building guidelines. Audubon Minnesota.
- Beginner's file. Catalan Butterfly Monitoring Scheme
- Favoriser les abeilles sauvages et la nature en ville. Ecological guide to urban and peri-urban green spaces [http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.showFile& rep=file&fil=URBANBEES_ guide_gestion_ecologique_0.pdf](http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.showFile& rep=file&fil=URBANBEES_guide_gestion_ecologique_0.pdf)

- Guide to living roof terraces and green roofs. Barcelona City Council. <http://cort.as/d21u>
- Papallones de la Serralada de Marina. Barcelona Provincial Council.
- Leaflet on the Collserola's butterflies

Useful addresses:

- Amics del jardí de papallones de Ca l'Arnús www.alocnatura.org
- Our environment's animals: Birds-Xtec www.xtec.cat
- Catalan Butterfly Monitoring Scheme www.catalanbms.org
- Discover bats www.ratpenats.org
- Catalan flora www.floracatalana.net
- Galanthus www.asgalanthus.org
- Catalan Institute of Ornithology www.ornitologia.org
- Granollers Science Museum www.museudegranollersciencies.org/caixes-niu/
- Nests-Welcome to nests www.nius.cat/ocells-i-bosc
- www.sostenibilitatbcn.cat/attachments/article/

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